GILA DRAIN

A660.90

Findings of Preliminary Study.

Strong local and congressional interest in the project indicated a need for a tentative answer on project feasibility as soon as possible. Standard project flood protection was not investigated during the preliminary studies first, because the upper three-quarters of drainage area had 100-year protection provided by extensive existing and proposed SCS projects; second, because of time and funds restraints. The study area is delineated on Plate 1. SCS projects are delineated on Plate 2. One-hundred-year protection was considered to be a representative degree of protection for preliminary studies. Standard project and other scopes and nonstructural solutions will be considered in the detailed studies.

A system of earth channels proposed by local interests extending from the Roosevelt Canal to the Gila River appears to be adequate for preliminary studies and was used to estimate project costs. Project location and costs are given on Plate 3 and Table 1. Justification of the Pecos Road and Hunt Highway floodways is doubtful at this time. The costs of these two floodways are not included in the average annual costs given below. Phased construction will be considered in the detailed studies. Channel alinement and lining require more study.

Equivalent annual benefits of $4,290,000 and costs of $1,860,000 were calculated using an interest rate of 5-5/8 percent and an economic life of 100 years. Benefit-to-cost ratio would be 2.3. Probable benefits for the following years, assuming future development restricted by a zoned floodway, are tabulated below.

INCL #4

Year Development	Probable Benefits
1974	$1,470,000
1980	1,700,000
1990	2,560,000

Conclusion and Recommendation from Preliminary Studies.

It was concluded that there is a Federal interest in providing flood damage reduction for the area. Structural solutions appear to be economically justified. It is recommended that more detailed studies be initiated. Findings of the preliminary studies will be reviewed and expanded to full survey scope. Structural and nonstructural solutions and combinations thereof will be considered. Alternatives promoting environmental quality will be investigated. The overflow area shown on Plate 4 will be extended to the Gila River and used in nonstructural studies. The photos on Plate 5 and 6 show runoff retention measures which have recently been required for new construction in the cities of Mesa and Tempe. The impact of these measures on future discharges will be fully evaluated.

~~It is recommended that detailed studies be initiated. Findings of the preliminary studies will be rigorously reviewed and expanded to full survey scope.~~

Public Involvement

Meetings have been held with the Maricopa County Flood Control District; Cities of Mesa, Tempe, and Chandler; SCS; BIA; Gila River Indian community; and engineering firms which have done studies in the area.

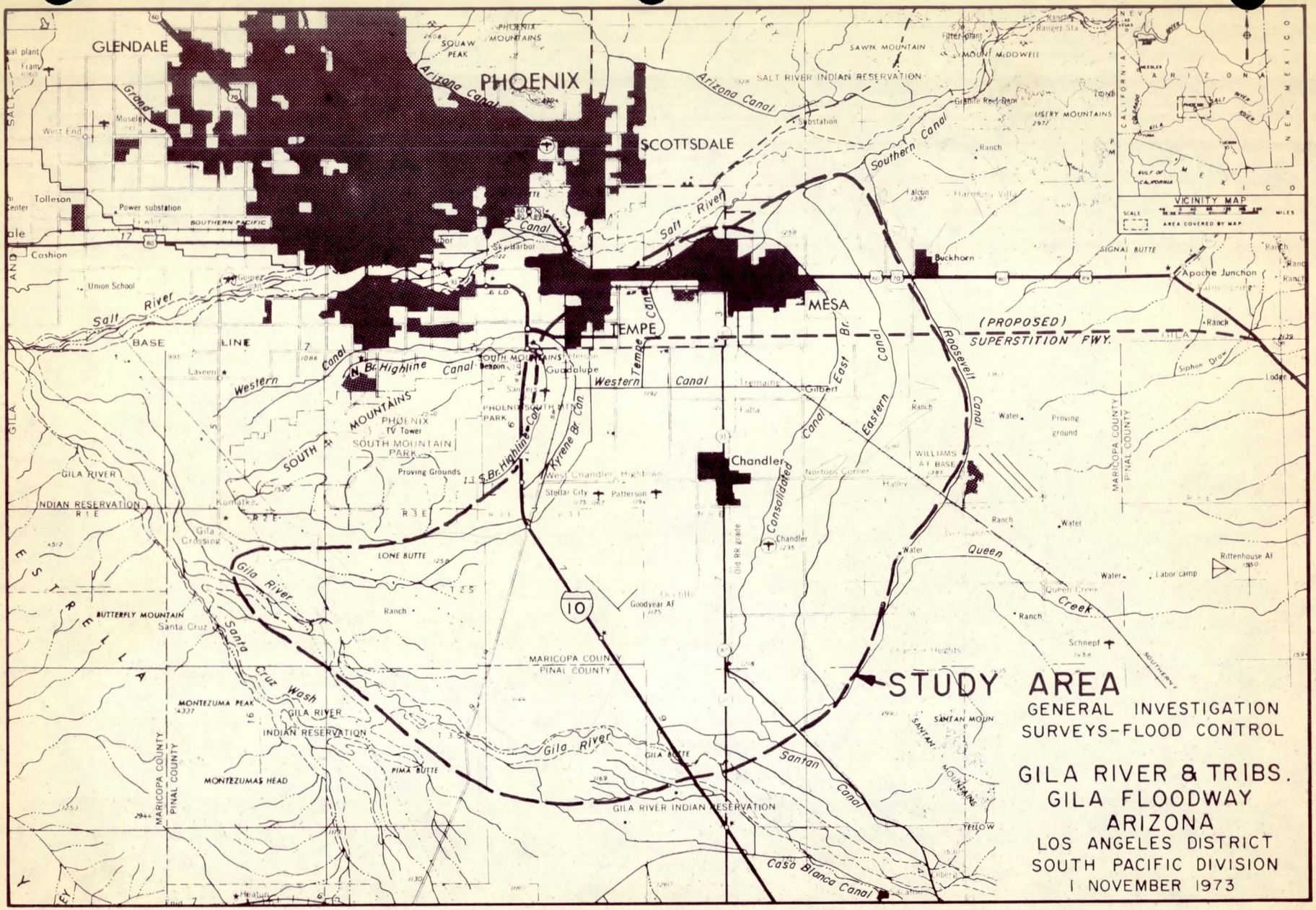
A public meeting was held on 13 December 1973. Various organizations presented statements in favor of a flood control project.

Maricopa County Board of Supervisors has appointed a 14-member Flood Control Advisory Group to achieve broader public input and citizen's reaction to proposed flood control plans and projects. We will work closely with this group in the plan formulation studies.

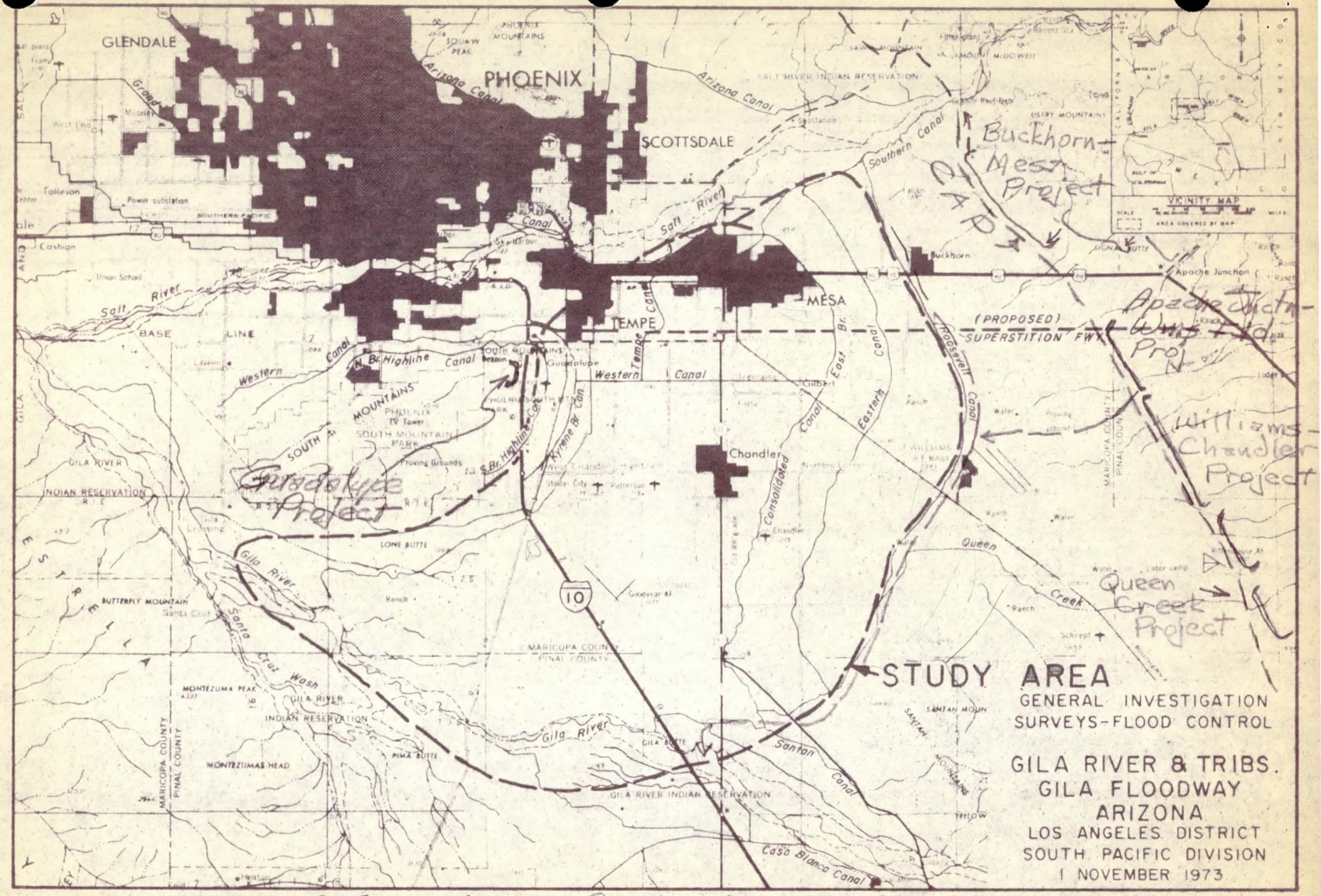
ALTERNATIVES TO BE CONSIDERED IN DETAILED STUDIES

In detailed studies the following alternatives should be considered:

1. Structural.
   a. Channels - earth and concrete.
   b. Channels combined with detention basins to reduce peak flows.
2. Non-structural.
   a. Zoned floodway.
   b. Floodproofing.
   c. Flood insurance.
   d. Evacuation - temporary combined with flood forecasting & permanent.
   e. Tax incentives to leave land in agriculture or open space.
   f. Other.
3. Combinations of structural and nonstructural.


GLENDALE
PHOENIX
SCOTTSDALE
TEMPE
MESA
Chandler
Arizona Canal
Salt River
Western Canal
Tempe Con
East Br. Eastern Canal
Roosevelt Canal
Consolidated Canal
Southern Canal
Santan Canal
Casa Blanca Canal
Gila River
Santa Cruz Wash
(PROPOSED) SUPERSTITION FWY.
SALT RIVER INDIAN RESERVATION
GILA RIVER INDIAN RESERVATION
GILA RIVER INDIAN RESERVATION
MARICOPA COUNTY
PINAL COUNTY
BASE LINE
VICINITY MAP
STUDY AREA
GENERAL INVESTIGATION
SURVEYS-FLOOD CONTROL
GILA RIVER & TRIBS.
GILA FLOODWAY
ARIZONA
LOS ANGELES DISTRICT
SOUTH PACIFIC DIVISION
1 NOVEMBER 1973

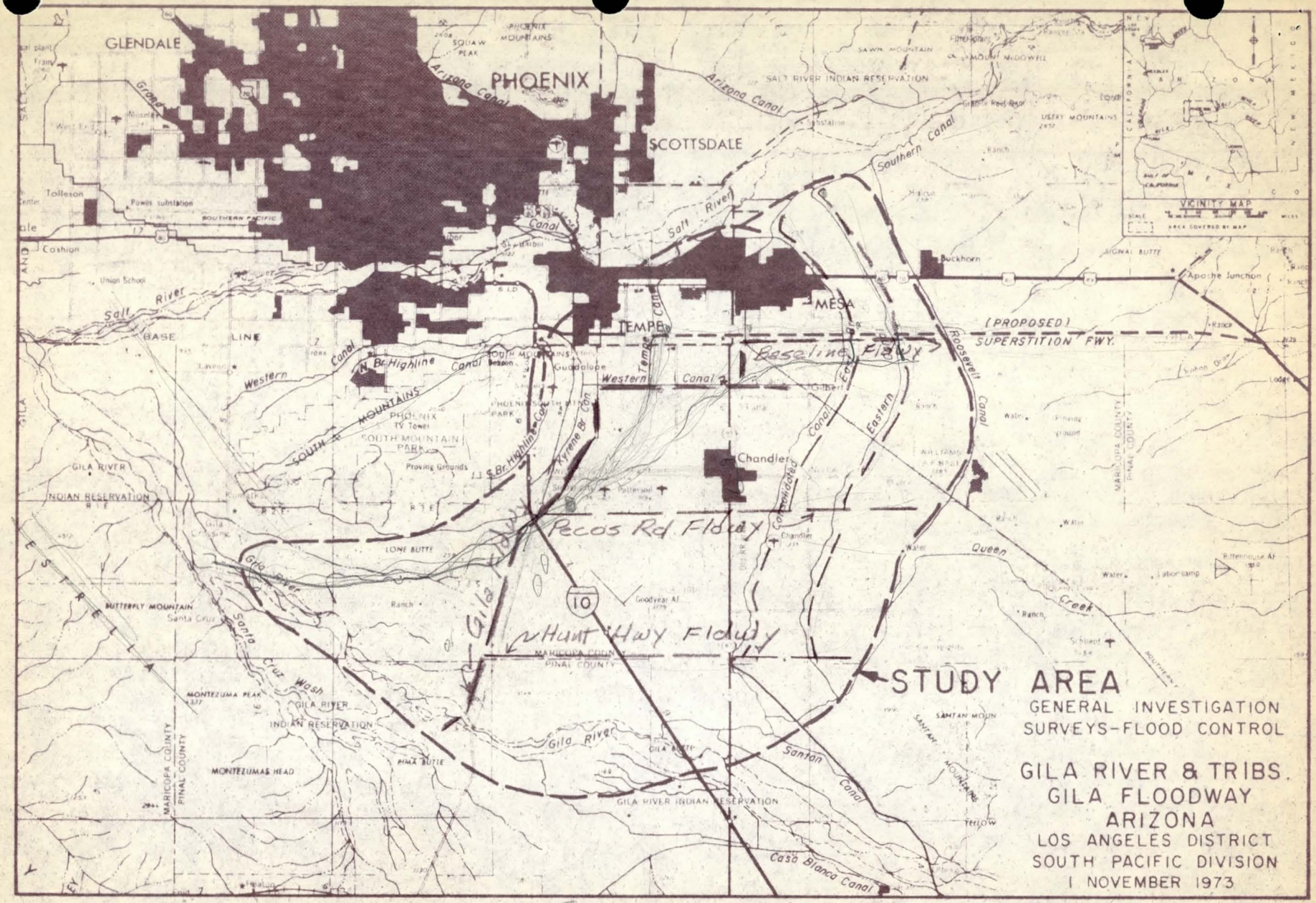
Attach #1



SCS - USBR Projects - April 1974

R2

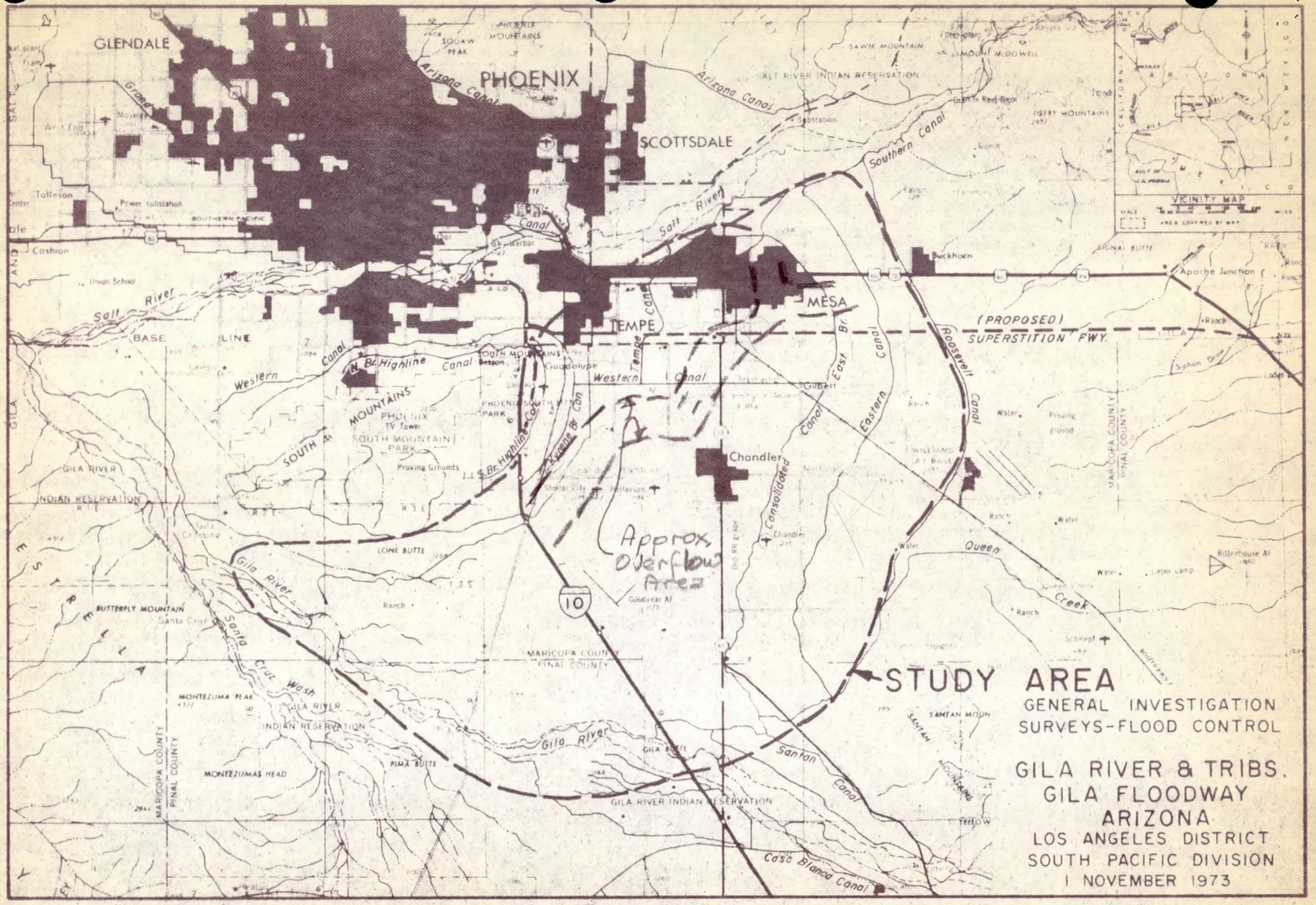
Attach #2



Proposed Gila Floodway Project April 74

P3

Attach #3



Approx. 100-yr. overflow Area - Present Dev. April 1974

Attach #4

PHOTO #1 ARTIFICIAL LAKES IN NEW SUBDIVISIONS SOUTH OF SUPERSTITION FREEWAY

PHOTO #2 NOTE POTENTIAL FREEBOARD STORAGE IN LAKES

FR.5

PHOTO #3 DEPRESSED YARDS BEING REQUIRED IN CITY OF TEMPE. NOTE THAT ONE OWNER IS FILLING IN HIS YARD.

PHOTO #4 DEPRESSED PARK IN NEW SUBDIVISION

TABLE ONE

SUBJECT: GILA FLOODWAY – EARTH CHNL – PROJECT COST | DATE: 4/15/74 | PAGE 1 OF PAGES

SOURCE OF DATA: MARICOPA COUNTY FLOOD CONTROL STUDY

COMPUTED BY: LDS | CHECKED BY: | SECTION: SPLED-WB

UNIT	Length	Base width range	Depth range	Reqd R/W	Const Cost	R/W & Relocs. Cost	Σ
	miles	feet	feet	acres	$1000	$1000	$1000
GILA DRAIN – UNIT 1 – Pecos Rd to Gila R.	9	255-358	10-14½	402	5,000	1,800	6,800
GILA DRAIN UNIT 2 – Pecos Rd to Western Canal	5	200-205	12½-13½	149	2,100	2,400	4,500
Western Canal – Baseline Rd Floodways	15¼	38-300	9½-13½	416	6,300	10,400	16,700
Tributary Floodways above Eastern & Consolidated Canals	13	30-85	6-13	189			
Σ	30 miles				sub Σ		28,000
					Annual @ 5⅝%, n=100		1,580
					O & M		180
					Decr. Productivity of Land		100
					TOTAL ANNUAL COST		1,860
Pecos Rd Floodway	10¼	58-98	8½-12	160	2,300	2,600	4,900
Tributary Floodways	11	25-66	5-9	146			
Hunt Hwy Floodway	11½	35-49	5½-6	111	1,400	1,300	2,700
Tributary Floodways	10	20-38	4-6	123			

WES FORM NO. 1114
JANUARY 1961

TABLE 1

Economic Base.

Population. The historic and projected populations for Maricopa County, the Cities of Phoenix, Tempe, Mesa, Chandler, Gilbert, and the overflow area are shown in the following tabulation. Future population figures are based on OBERS projections allocated to Maricopa County by the Arizona Water Commission and suballocated by the Corps among the various cities in the area on the bases of historical trends and expected development patterns.

Population trends

Year	Maricopa County	City of Phoenix	City of Tempe	City of Mesa	City of Chandler	City of Gilbert	Overflow Area
1950	331,800	106,800	7,700	16,800	3,800	1,100	NA
1960	663,500	439,200	24,900	33,800	9,500	1,800	NA
1970	962,500	581,600	62,900	62,900	13.800	2,000	9,000
1980	1,328,700	737,000	120,000	105,000	20,000	2,200	13,100
000	1,930,900	845,000	220,000	255,000	60,000	5,000	17,900
2020	2,539,500	880,000	280,000	365,000	135,000	20,000	28,100

In 1940 the population of the Phoenix metropolitan area was about 92,000 people. By 1970, there were approximately 867,000 people living in 19 cities. The 1970 figure was an 844-percent increase over the 1940 figure or almost an 8-percent average annual increase. In 1970 the Phoenix area contained 49.4 percent of the State's population. The City of Phoenix is by far the most populous city in the Phoenix area; however its relative importance in both population and employment will decrease steadily as the surrounding areas grow.

Recent development trends in the Phoenix area may be shown by considering the period 1960-1970. Over this span, the population increased from about 52,000 to 867,000 people. This was an absolute increase of 315,000 people, which is an average annual increase of 4.6 percent.

The greatest rate of growth occurred in the City of Scottsdale with an average annual increase of about 21 percent. The City of Tempe was second with more than a 9.5 percent annual increase, followed by the City of Glendale with about an 8.5 percent annual increase and Mesa with 6.4 percent annual increase.

CURRENT AND FUTURE LAND USE. The patterns of current and future land use in the Phoenix metropolitan area are discussed in the following paragraphs.

The general pattern of recent growth in the Phoenix area (1960-1970) is indicated on plate 7. This plate also shows the topographic constraints of mountains and flood plains as well as the Indian lands, which at present bar development on the east but which are expected to be opened to development at a slow rate in the near future. During the 1960's, 315,000 people were added to the Phoenix metropolitan area. (See red areas on pl. 7.) This increase in population required the use of about 73,000 additional acres in the Phoenix area. The added population was absorbed both by an increase in densities in the developed parts of the Phoenix area and by development of large new low-density areas on the periphery. During the 1960's, development spread to the east into the City of Scottsdale, southeast into the City of Tempe, and the City of Mesa, north up to North Mountain and Shaw Butte in the City of Phoenix, and west into the Maryvale area of the City of Phoenix and into the vicinity of the City of Glendale, with slower expansion into areas in south Phoenix.

Empirical analysis of past patterns of development in the Phoenix area has shown that most development during the initial period of spillover into a given area is on land of less than 25-percent slope. Steep, precipitous hillsides are not considered suitable for high-density urban development because of the relatively high costs of development and the community opposition to scarring the picturesque desert mountains.

Consequently for future population projections, areas of steep slopes may be considered almost completely undevelopable without severely distorting the projections. The criterion of 25-percent slope in defining limits of land suitable for development is generally applicable to cities in the Phoenix metropolitan area. The areas with slopes greater than 25 percent are indicated on plate 7. Additional constraints on growth are lands which have been withdrawn from potential development by Federal and State authorities for use as national forest preserves, State and Federal parks and monuments, Indian land, and military reservations. Additionally, current Arizona State law and ordinances of Maricopa County and the City of Phoenix restrain urban development within 100-year flood plains.

It is anticipated that development in the Phoenix metropolitan area during the next 50 years (see pl. 8) will spread to the southeast into the Tempe area during the 1970's, the Mesa area and south of Tempe during the period 1980-2000, and the Chandler area during the period 2000-2020. Urbanization will also spread northward from the City of Phoenix, reaching beyond Lookout Mountain by 2020. Development is also expected to spread westward, filling in the areas around the City of Glendale and the Maryvale part of the City of Phoenix during the 1970's, filling in the remaining western part of the City of Phoenix during the period 1980-2000, and reaching the Agua Fria River by 2020. Simultaneously, development will spread at a slower rate into the areas south of the Salt River in south Phoenix, approximately doubling existing developed acreage during the next 50 years.

D R A F T

12 April 1974

PROJECT BENEFITS

The primary benefit that would accrue to the alternatives analyzed in this report is the reduction of flood damage in the Cities of Tempe and Mesa. The type of property that would be protected is primarily residential and commercial development. About 11,598 acres lie within the future 100-year overflow area of which 1,936 acres are currently in urban use.

Future development was projected to conform to OBERS population projections for the Maricopa County and the Maricopa Association of Governments' Land Use Plan. Anticipated future growth of the Phoenix urbanized area is shown on plate 8. Future development was not projected within the 100-year floodway as well as the 1973 flood DFP as current State of Arizona regulations prohibit such development. A summary of present and future land use in the future 100-year overflow area is shown in table 3.

Estimates of existing (1974) property values were made by using (a) the assessed valuations of the County Assessor adjusted to the market value of the property, (b) valuation data furnished by owners and managers of property, and (c) field inspections and appraisals of the present development in the overflow area. Using economic trends, city and county plans, and recent development, estimates of future values of the property were made. Factors reflecting projected increases in personal income and the level of economic activity were applied to indicate recent economic outlook. Projected increase in personal income was based on the 1968-2020 projected average increase in per capita income made by OBERS, amounting to 2.8 percent a year for the Gila-Salt Water Resources Subarea in which the Phoenix metropolitan area is the major urban area.

A study made by the Los Angeles District indicates that:

a. Per capita consumption of selected damageable items in the United States (1950-1968) in 1958 dollars has increased an average of 3.054 percent a year while personal income increased 2.521 percent a year. A correlation analysis of the data for damageable items and personal income for this period reveals a coefficient of correlation of .995.

b. Commercial construction costs and inventories have increased an average of 2.32 percent a year as compared with average personal income, which had risen an average of 2.521 percent a year. A correlation analysis relating average annual percentage increase in commercial construction costs and inventory with average annual percentage increase in personal income indicates a coefficient of correlation of .968. Overall, it is expected that residential damageable value per acre would increase at a rate equal to the increase of personal income, or about 2.8 percent a year. For commercial property, the OBERS annual personal income increase was also applied directly to total damageable value on the basis that the value of most damageable elements of a commercial establishment are highly sensitive to the general wealth of potential consumers. Public property avlues were estimated to follow the same trends as residential and commercial properties.

Due to forecast uncertainties, increases in the value of property were discountinued after the first 50 years of project life. A summary of estimated present (1974), present with productivity increases applied, and equivalent annual values of property in the future 100-year overflow area is shown in table 4.

Damages were estimated for each of selected flood magnitudes by the following procedure:

a. Hydraulic studies were made to determine the extent of the overflow area, the depth of inundation, and the velocity of the flow. Average depths were as follows:

Flood	Average Depth
Future 100-year	1.8'
100-year	1.6'
50-year	1.5'
25-year	1.2'

b. Depth-damage relationships, based on records of past floods and evaluation of potential flood damages to various types of properties, were applied to each property subject to inundation.

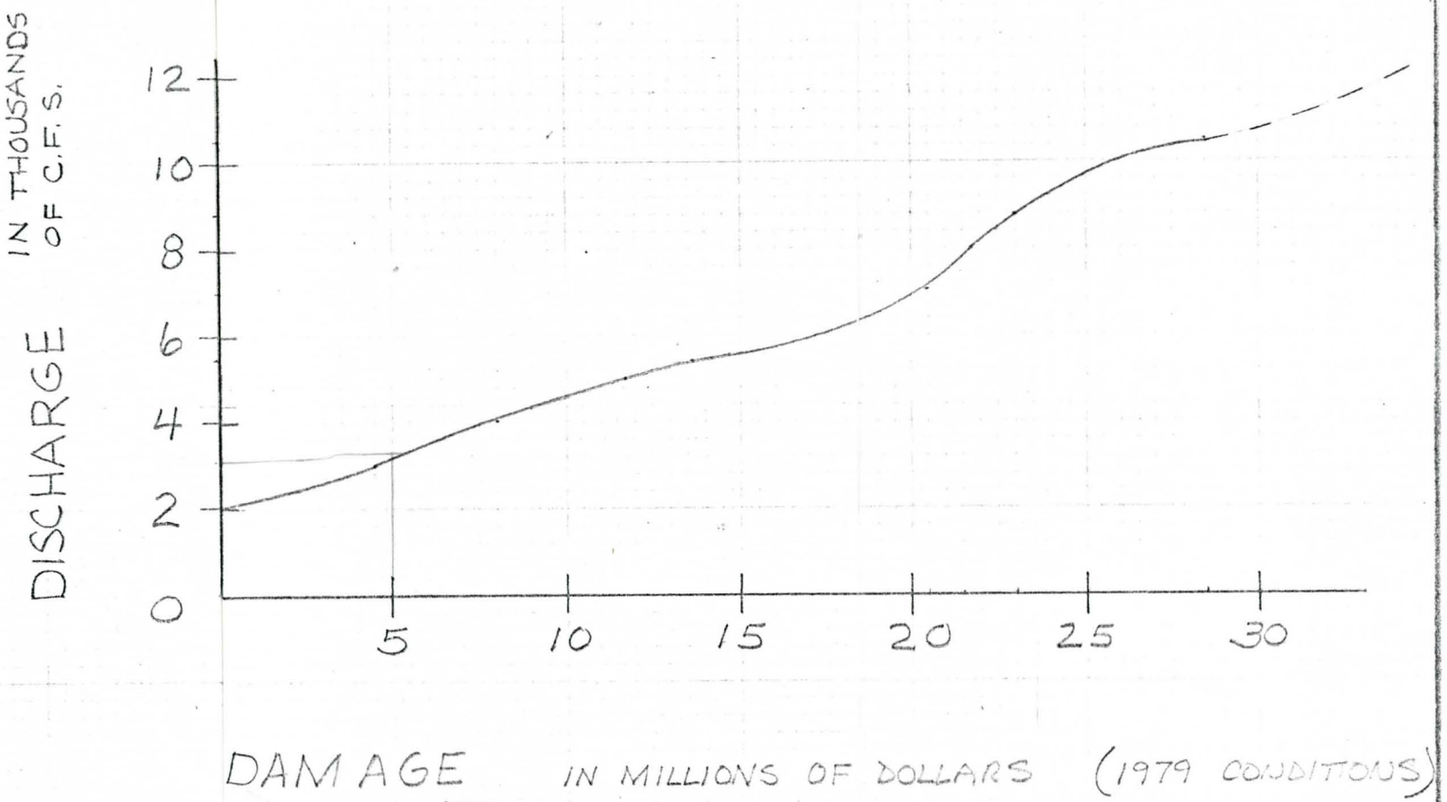
c. The individual damages to each property type were totaled. Curves showing damage-discharge and damage-frequency relationships under year-one (1979) conditions are shown on figure 1. The damage-discharge curve was combined with the discharge-frequency curve to obtain the damage-frequency curve. The area under the damage-frequency curves represents the estimated probable annual flood damages in the overflow area under 1979 conditions of development.

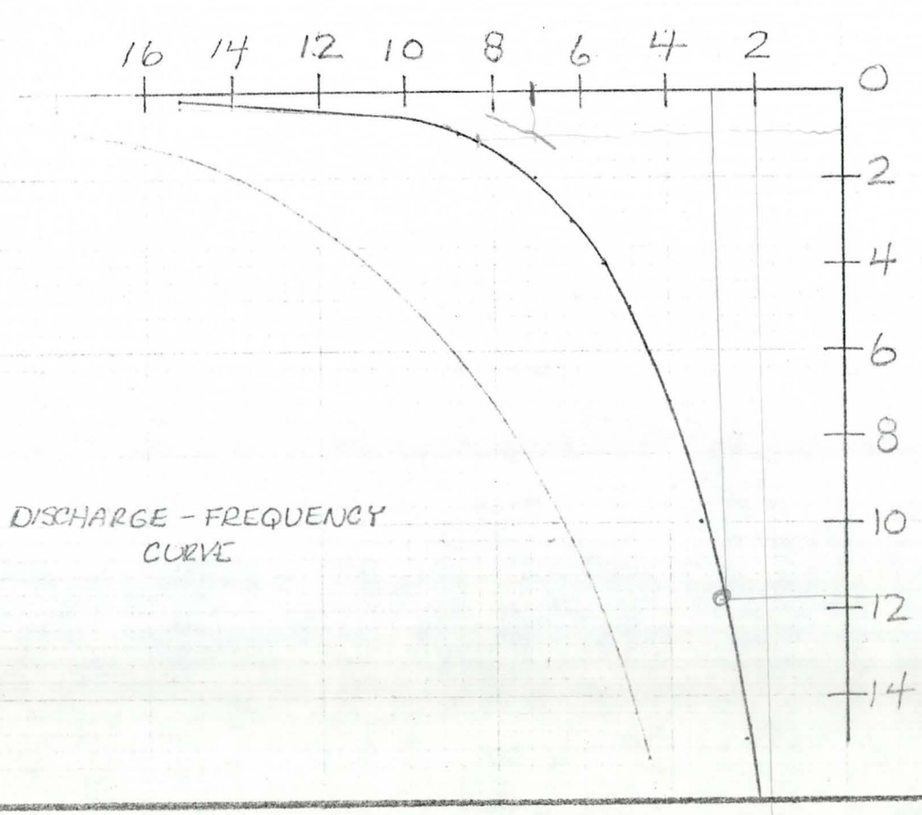
The nonpreventable damage-frequency curve, indicating the estimated residual damages that would occur after construction of the plan of improvement under consideration, is also shown. The total undiscounted and discounted probable damage and the total equivalent annual damages (5-5/8 percent-100 years) is shown in figure 2. The total equivalent annual flood damages that would occur in the area under study are estimated at $4.4 million. The total benefits from flood damage reduction (1980-2079: 5-5/8 percent) would be $4,290,000.

At present, Arizona State Law and Ordinances of the City of Phoenix and Maricopa County require that future urban development remain outside the limits of 100-year floodways. Although the overflow area under study has not to date been defined as a floodway by the Arizona Water Commission, this study assumed that it would be so designated in the near future. Benefits from increased utilization of land would accrue to the proposed project, but have not been analyzed. It is anticipated that an additional 3,500 acres in the flood plain would be converted to urban uses by 2030 if flood protection were provided.

GILA

DRAIN





PERCENT CHANCE DISCHARGES ARE EQUALLED OR EXCEEDED

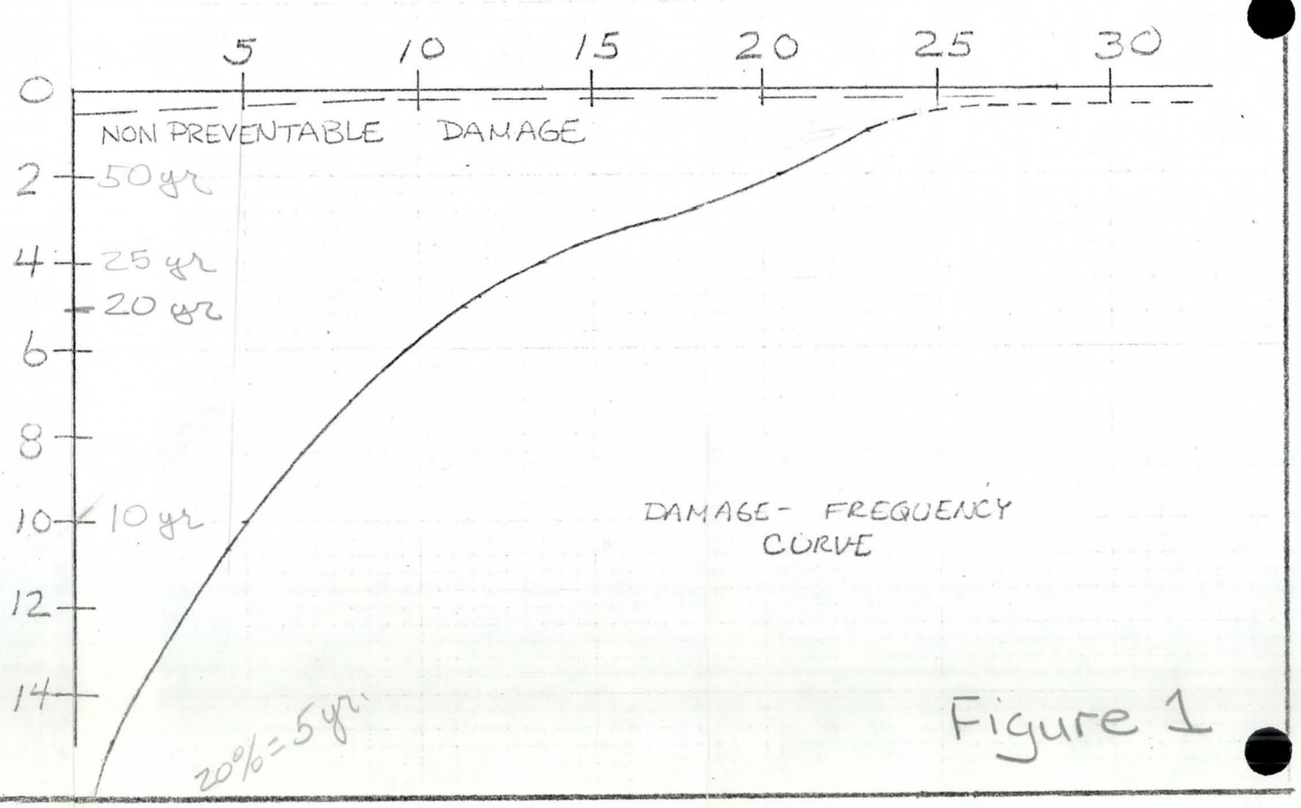


Figure 1

PROBABLE AND EQUIVALENT ANNUAL DAMAGES

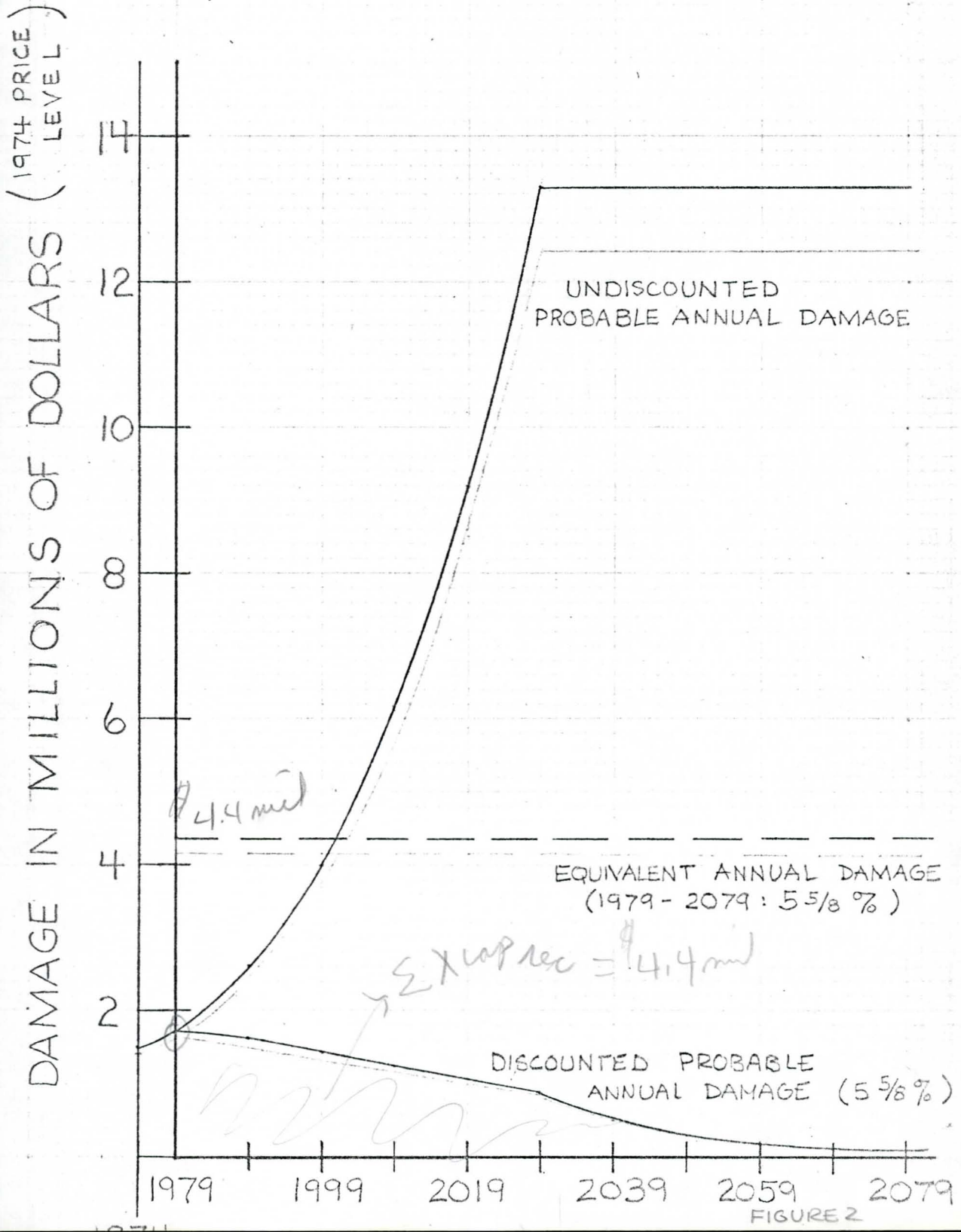


FIGURE 2

Table 3

GILA DRAIN

ESTIMATED LAND USE (ACRES)

Type of Development	1974		1979		1999		2019		2039
Residential	1627	85	1712	671	2383	1346	3729	83	3812
Commercial	168	124	292	52	344	70	414	10	424
Public	144		114		179		192		192
Parks	27		27		37		46		48
Agriculture	9662		9453		8655		7217		7122
Total	11,598		11,598		11,598		11,598		11,598

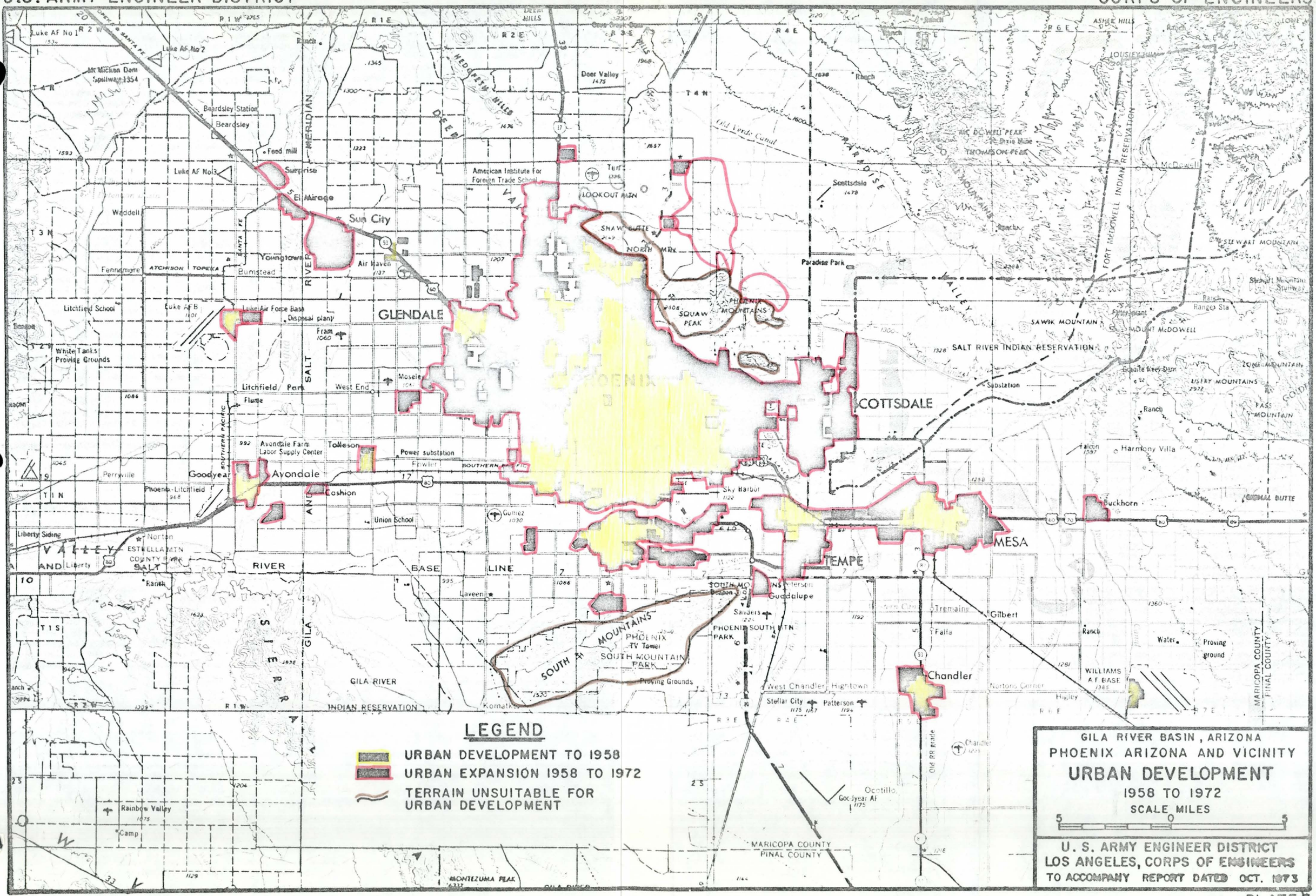
Table 4

GILA DRAIN

SUMMARY OF ESTIMATED VALUE OF DEVELOPMENT

Type of Development	Present Value Per Acre of Improvement	Present Value Per Acre of New Improvement	Present Value	Present Development Equivalent Annual Value	Future Development Equivalent Annual Value
Residential	57,600	140,000	93,800	190,300	502,400
Commercial	276,000	300,000	46,500	94,300	210,000
Public	90,600	150,000	10,300	20,900	39,400
Parks	65,000	3,000	1,800	1,800	1,800
Agriculture	200	200	1,900	2,900	2,600
Total	---	----	154,300	310,200	756,200

U.S. ARMY ENGINEER DISTRICT — CORPS OF ENGINEERS



LEGEND

- URBAN DEVELOPMENT TO 1958
- URBAN EXPANSION 1958 TO 1972
- TERRAIN UNSUITABLE FOR URBAN DEVELOPMENT

GILA RIVER BASIN, ARIZONA

PHOENIX ARIZONA AND VICINITY

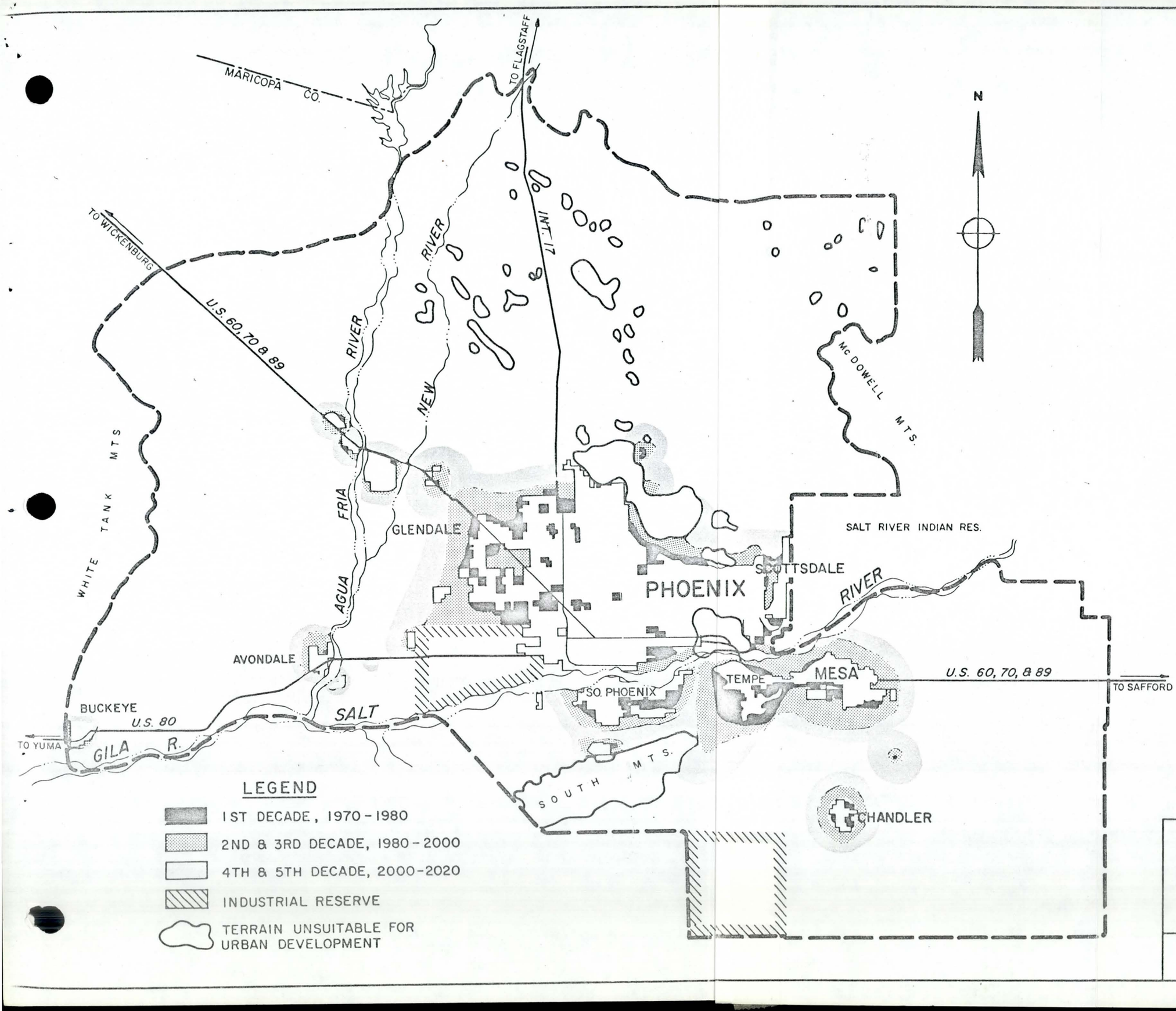
URBAN DEVELOPMENT

1958 TO 1972

SCALE MILES 5 0 5

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED OCT. 1973

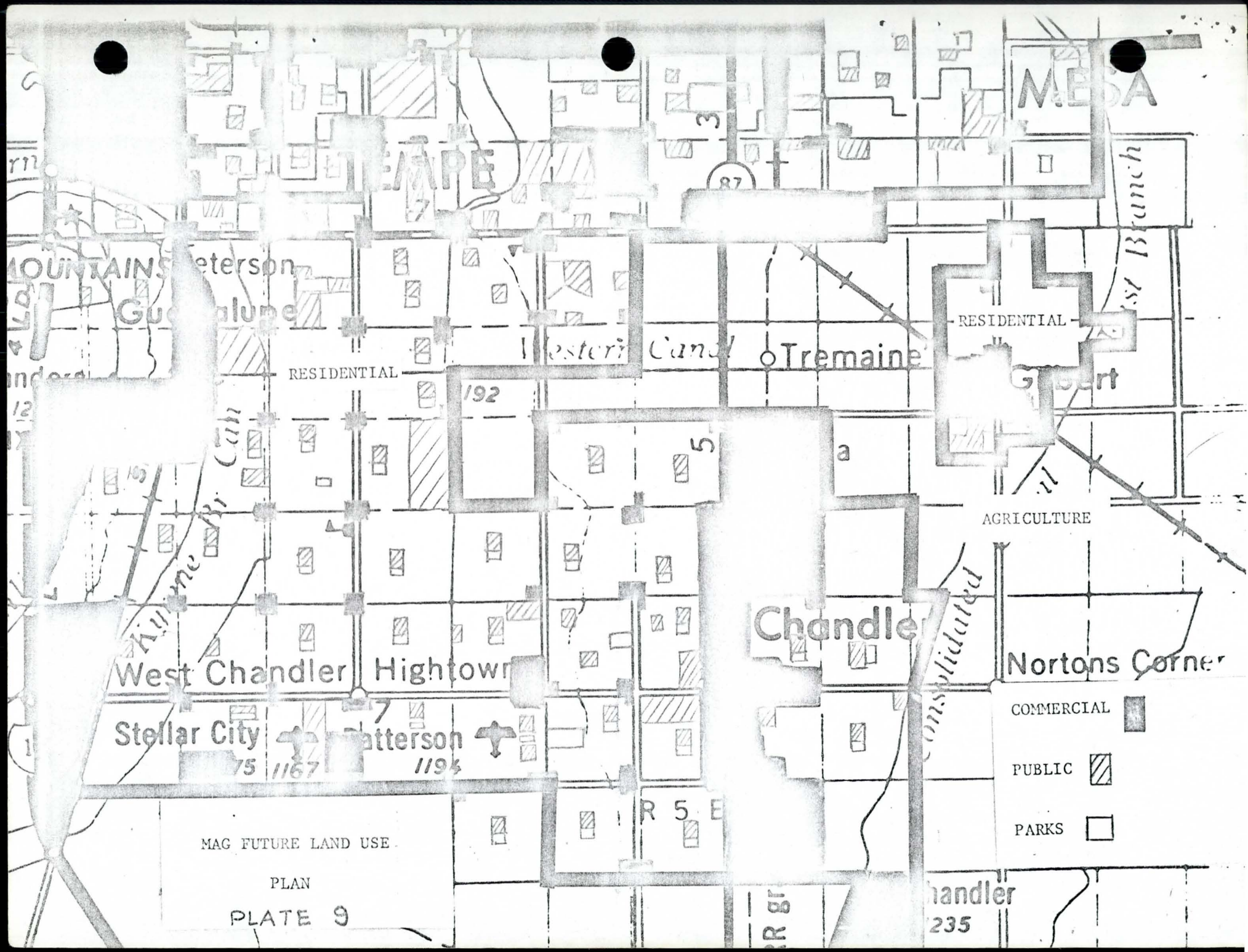
PLATE 37



GILA RIVER BASIN, ARIZONA
INDIAN BEND WASH
PHOENIX ARIZONA AND VICINITY
EXISTING & PROJECTED
URBAN DEVELOPMENT
1970 - 2020

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS

PLATE 48


MESA
RESIDENTIAL
Tremaine
RESIDENTIAL
AGRICULTURE
Chandler
West Chandler
Hightown
Stellar City
Patterson
Nortons Corner
COMMERCIAL
PUBLIC
PARKS
MAG FUTURE LAND USE
PLAN
PLATE 9

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, CORPS OF ENGINEERS
P. O. BOX 2711
LOS ANGELES, CALIFORNIA 90053

SPLED-WH

17 April 1974

MEMORANDUM FOR: CHIEF, INVESTIGATION SECTION B

SUBJECT: Hydrologic Investigation for Gila Floodway

1. A preliminary hydrologic investigation of the Gila Floodway under no-project conditions was conducted in support of Phase 1 economic analysis. Peak dishcarges were computed for the 100-, 50-, and 25-year floods under present (1980) and ultimate (2080) conditions. These discharges are listed in Table 1.

2. The assumptions made for this investigation concerning manmade alterations to existing flow patterns were:

a. The proposed Superstition Freeway was in place by project year 1 (1980). Floodflows originating north of the freeway collected at Horne Street and flowed over the freeway at that location.

b. For present conditions no on-site (within developments) detention storage was considered.

c. For future conditions an analysis was made both with an without on-site detention storage.

d. On-site detention storage reduced floodflows from new developments south of the western canal by 20 percent.

e. Soil conservation service levees and detention structures controlled all flows up to and including the 100-year flood originating above the Roosevelt Canal.

f. Urban storm drains designed for 2-year storms had no effect on major downstream floodflows.

3. The method used to develop the peak discharges was the single linear reservoir method. 100-year 6-hour, 50-year 6-hour, and 25-year 6-hour precipitation amounts were from maps of rainfall-frequency prepared by the U. S. Weather Bureau. The storm pattern used was derived from the Arizona standard project summer thunderstorm. Constant loss rates of 0.40, 0.45, and 0.50 inches per hour were used for the 100-, 50-, and 25-year storms, respectively. These loss rates were estimated from plate 27 of the report

SPLED-WH 17 April 1974

SUBJECT: Hydrologic Investigation for Gila Floodway

"Gila River Basin, New River and Phoenix City Streams, Arizona, Design Memorandum No.2, Hydrology Part I", dated October 1973, by accumulating rainfall lost up to the period that the peak rainfall amount occurred, and using the corresponding loss rate from the "Dry Watershed Curve". Channel routing was accomplished using the Muskingum method with an X of 0 and K equal to travel time, which was determined from normal depth computations.

Robert L. Hall

ROBERT L. HALL
Chief, Hydrologic Engineering Section

Incl
as

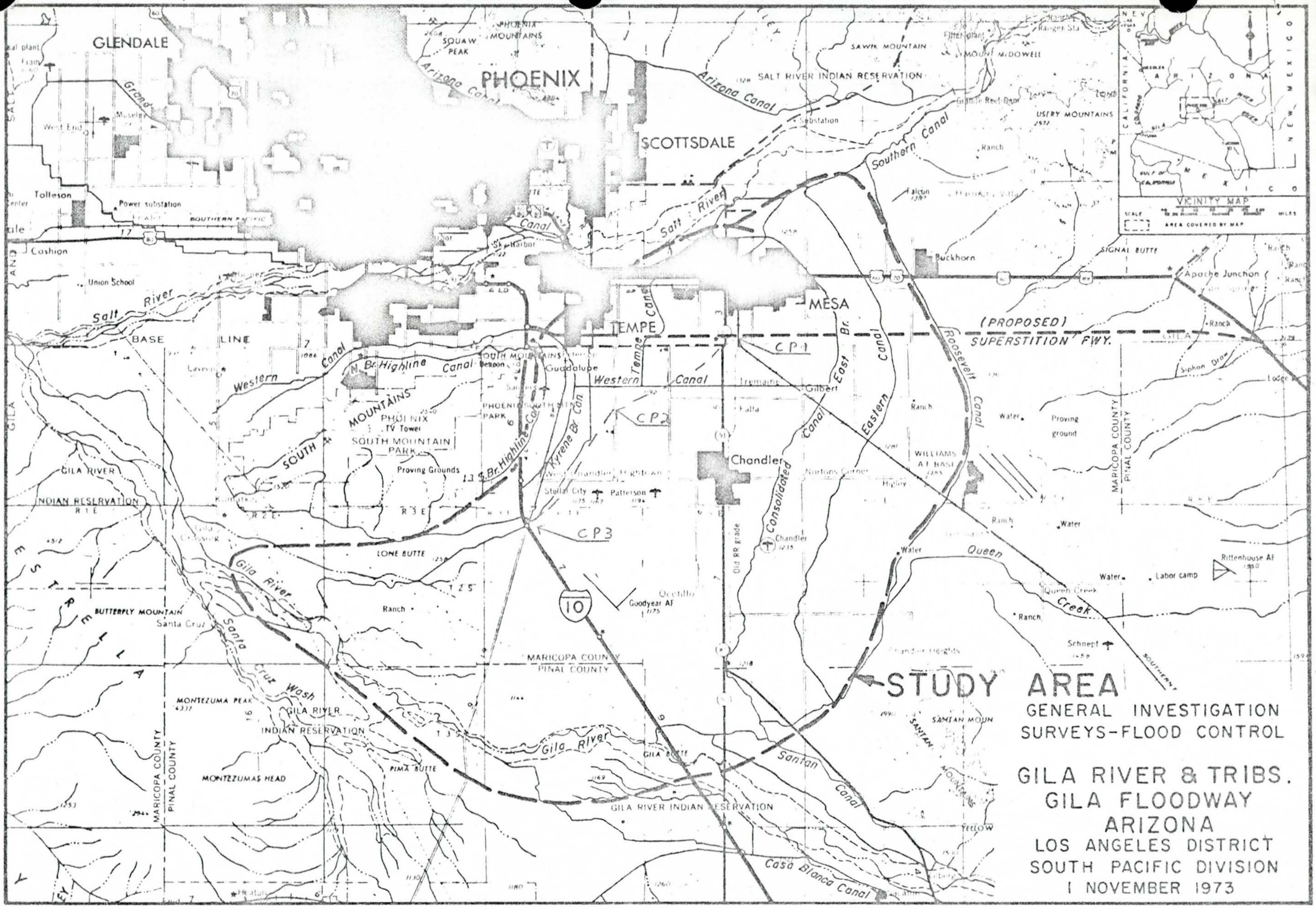
CF:
Inv. Sec. A
FPMS
Channels Sec
Ariz Proj. Ofc

TABLE 1

Return Period	C. P. NO. 1* =1701 Discharge Present Conditions	Discharge Future Conditions	Discharge** Future Conditions with some Detention Storage	C. P. NO. 2* =1304 Discharge Present Conditions	Discharge Future Conditions	Discharge Future Conditions with some Detention Storage	C. P. NO. 3* =1310 Discharge Present Conditions	Discharge Future Conditions	Discharge Future Conditions with some Detention Storage
Years	CFS	CFS	CFS						
25	5400 1000	7,100	7,100 700	5500	7,200	7,000	6,100 700	8,100	7,000 2100
50	7000 1700	8,800	8,800 1400	7100	8,900	8,700	7,900 1500	10,000	8,900 2800
100	8900 2600	10,500	10,500 2400	8900 400	10,500	10,400 700	10,000 2300	12,100	10,900 3800
SPF	5100		5100	4400		4100	20,000		17,000

*See Plate 1 for location.

** No detention storage above this point.


GLENDALE
PHOENIX
SCOTTSDALE
TEMPE
MESA
Chandler
Tolleson
Guadalupe
Gilbert
Buckhorn
Apache Junction
SQUAW PEAK
PHOENIX MOUNTAINS
SAWIK MOUNTAIN
MOUNT McDOWELL
SALT RIVER INDIAN RESERVATION
USERY MOUNTAINS
Arizona Canal
Southern Canal
Salt River
Grand Canal
Western Canal
N. Br. Highline Canal
S. Br. Highline Canal
Kyrene Br. Can
Tempe Canal
Consolidated Canal
Eastern Canal
East Br. Canal
Roosevelt Canal
Queen Creek
Santan Canal
Casa Blanca Canal
Gila River
Santa Cruz Wash
(PROPOSED) SUPERSTITION FWY.
BASE LINE
CP1
CP2
CP3
SOUTH MOUNTAINS
PHOENIX TV Tower
SOUTH MOUNTAIN PARK
Proving Grounds
PHOENIX SOUTH MOUNTAIN PARK
WILLIAMS AF BASE
LONE BUTTE
GILA BUTTE
PIMA BUTTE
BUTTERFLY MOUNTAIN
MONTEZUMA PEAK
MONTEZUMAS HEAD
SANTAN MOUN
ESTRELLA
GILA RIVER INDIAN RESERVATION
MARICOPA COUNTY
PINAL COUNTY
Goodyear AF
Chandler
Schnepf
Rittenhouse AF
SIGNAL BUTTE
10
VICINITY MAP
ARIZONA
NEW MEXICO
CALIFORNIA
MEXICO
GULF OF CALIFORNIA
AREA COVERED BY MAP
STUDY AREA
GENERAL INVESTIGATION
SURVEYS-FLOOD CONTROL
GILA RIVER & TRIBS.
GILA FLOODWAY
ARIZONA
LOS ANGELES DISTRICT
SOUTH PACIFIC DIVISION
1 NOVEMBER 1973

GILA FLOODWAY

PRELIMINARY ENVIRONMENTAL ASSESSMENT

PREPARED BY

U.S. ARMY ENGINEER DISTRICT

LOS ANGELES, CALIFORNIA

REVISED 15 APRIL 1974

Purpose and Scope. This assessment identifies the most significant environmental elements pertinent to the Gila Floodway and assesses the significant environmental considerations that could effect project formulation. The assessment was based on preliminary field and office investigation and limited coordination with agencies. Further investigation will be needed to prepare a quantified environmental inventory and impacts analysis. The environmental elements deemed most critical in the study area are archeological resources, the presence of rare or endangered species, socio-economic conditions, and ground water. These elements are considered in following paragraphs. Significant environmental considerations are discussed in the final paragraph.

Study Area. The study area is bounded by Apache Boulevard on the north, Interstate 10 on the west, Pecos Road on the south, and Reebs Road (Val Vista Drive) and the Consolidated Canal on the east. Plate 1 shows the boundaries of the study area in red, and the overflow for a 100 year frequency flood in blue.

Archeological Resources. Contacts were made with the following agencies to determine potential environmental problems: the Arizona Archeological Center of the National Park Service, the State of Arizona Historical Preservation Officer, the Arizona State University Department of Anthropology, and the Arizona Highway Department. Our inquires stressed the presence of sites listed in the National Register. The State of Arizona Historical Preservation Officer indicated that there are no sites currently listed on the National Register in the study area,

nor any sites under consideration for nomination. The Historical Preservation Officer indicated, however, that Williams Air Force Base, which is just outside the eastern limit of the study area has an archeological site, the Midvale site, that is currently being considered for the nomination to the National Register of Historic Places.

The archeological history of the region, including the study area, deals primarily with the Hohokam, an agricultural people who made their living by gathering natural vegetation and by farming the rich lands boardering the rivers. For the first 1000 years of their occupation of the Salt River Valley, the Hohokam lived in villages of various sizes made up of pit houses. Sometime around 1100 A.D. the pithouses changed to surface rooms with joined walls. Sites became large, approaching city-like proportions, and were in great density in the valley. Irrigation systems were enlarged and expanded, bringing more land under cultivation. These large sites were abandoned suddenly, and by the middle of the 15th century the cities and the canals had fallen into disuse and ruin, and the Indian population had dispersed. Anglo settlers arriving in the 19th century began to farm the same land abandoned by the Hohokam. In some cases the old canals were cleaned and reused to water the modern fields. In the late 19th century the cities of Chandler, Tempe, and Mesa were founded and began to grow. As they grew, and as more land around them came under cultivation, the Hohokam sites began to disappear under agricultural fields and urbanization. As the growth of the cities accelerated in the late 1920's and in the 1930's, so did the destruction of the sites.

Despite the great wealth of sites, there have been few major excavations in the Salt River Valley. The Hemenway Expedition of 1888 explored Los Muertos, a large village northwest of Chandler, as well as several smaller sites. Results of this work were published in 1945. In the 1930's excavations were conducted at Pueblo Grande in Phoenix. Although this site has been partially preserved as a city park, there has been little published on the work done there.

The present condition of the two sites mentioned above typifies most of the ruins in the Salt River Valley. Los Muertos has fallen victim to expanding land cultivation, and now lies under cotton fields. A small part of the Pueblo Grande site has been preserved as a city park; the part of the site outside of the park is under the city. Farming has created a twofold problem with regard to the archeological resources in the study area. First, the destruction of the original land surface through farming activities has made recognition of sites almost impossible. The sherds, flakes, and stone tools commonly used as surface indicators of sites have been buried, broken, and scattered, making identification of the site areas difficult. Second, crops obscure the ground surface and make survey identification impossible.

Biological Resources. Field surveys and searches of local literature indicate that no rare or endangered species inhabit the study area. The vegetation of the study area has been extensively altered by agricultural activities and urbanization. No natural communities exist in an undisturbed condition in the study area. The agricultural lands offer some measure of protection and food to birds and small mammals.

Those wildlife species present in the study area are tolerant of man's activities.

Land Use and Demography. Field surveys and analyses of aerial photographs were used to assess the existing land use in the study area. The Composite Land Use Plan for Maricopa County, Arizona, prepared by the Maricopa Association of Governments (MAG) was used as a basis for projecting future land use in the study area. Table 1 compares the present and projected future(2030) land uses in the study area. Table 2 compares the present land use with the projected future land use in the 100-year future overflow area. Table 1 shows that the conversion of agricultural land to other urban land uses will have a major effect on the study area. Table 2 shows that the present (mid 1974) population of the study area, based on MAG 1975 projections, is about 160,000. The 100-year overflow area presently supports about 3,600 housing units, containing a population of approximately 12,000.

Assuming a continuation of recent trends and conforming to local land-use plans, the additional 2,200 acres projected by MAG to be converted to residential use by 2030 could support 6,600 additional housing units. The overflow area could, with this many housing units, have a total future population of nearly 35,000 people. Acreage figures reflect the fact that: future development was not projected within the 100-year floodway due to Arizona State law and Maricopa County ordinances.

Housing in the floodway ranges in market value from under $12,000 to over $60,000. Significant community facilities in the floodway include:

the grounds of the Arizona Mormon Temple, one high school, one junior high school, and two elementary schools. Significant commercial/ industrial facilities in the floodway include the John Deere Tractor Plant, The Caterpillar Tractor Plant, and the maintenance base yards for the Mountain Bell Telephone Company, and the Line Construction Power Division of the Salt River Project.

Socio-Economic Profile. The 1970 census indicates that of the 143,958 residents of the study area, over 97 percent were white in race. Some 86,018 (59.8 percent of the total population) were in the prime working age of 16 to 64 years old. Persons over 65 accounted for 8.6 percent (12,376 persons) of the population. Civilian employment totaled 53,146 or 96.2 percent of the civilian work force. Therefore, the unemployment rate of 3.8 percent was below the national average of 4.9 percent. The median family income was $9,713 with 8 percent (2,835) of the families below the poverty level. This compares to national figures of $10,100 and 9.9 percent, respectively. Following is a summary of employment by industry for the study area and nation as a whole:

	Study Area		United States	
	Number (000)	Percent of Total	Number (000)	Percent of Total
Agriculture.....	1.761	3.3	3,462	4.7
Mining.....	.296	.6	622	.8
Construction.....	3.802	7.2	3,345	4.5
Manufacturing.....	10.963	20.6	19,369	26.1
Transportation and public utilities..	2.308	4.3	4,504	6.1
Wholesale and retail trade.....	11.725	22.2	14,922	20.2
Finance, insurance, and real estate...	2.843	5.3	3,690	5.0
Services.....	7.519	14.1	11,630	15.7
Government.....	11.929	22.4	12,535	16.9
Total.....	53.146	100.0	74,079	100.0

The study area's higher participation in construction reflects the recent dynamic growth of the Phoenix area. Government labor force participation is high because Phoenix is Arizona's state capital. Tourism and retirement play a more important part in Phoenix's economy than nationally, as reflected, in higher trade employment and lower employment in the manufacturing sector.

Groundwater. Because of declining groundwater levels, the State of Arizona has designated the Phoenix area, including the study area, to be a critical groundwater basin. The overdraft of the available groundwater in the study area, has come about because of the extensive agricultural development. Agricultural land presently accounts for nearly 75 percent of the land in the study area.

Significant Environmental Considerations. With respect to the significances of archeological resources in the study area, two points must be kept in mind. First, sites disturbed by plowing could still be present below the "plow zone" (the depth to which the soil has been broken by plowing) if the site had considerable depth to begin with. Features below a depth of 12 to 18 inches

(houses, cremations, hearths, etc.) may survive intact. Second, archeological remains may exist within the project area that have not been recognized because of plowing or the presence of crops. The potential for archeological sites in the study and project area (the 100-year future overflow area) is high, and will be a major concern in formulating structural alternatives. Study and field survey by professional archeologists should be initiated as soon as possible. Our best judgment, at this time, is that archeological resources will be a consideration in formulation of any structural alternatives.

Our best judgment is that biologic considerations will have a minor effect on project formulation.

Groundwater quality is of such importance to the economic well-being of the region that any project must take into consideration its effects on groundwater recharge. If the urbanization projected by MAG is realized, there will be a considerable reduction in the amount of agricultural land under cultivation in the study area. Several studies have estimated that less water is used as land moves from agricultural to urban land uses. The ratio between the agricultural use of water and the urban use of water is estimated from between 1:1 (no difference) to 10:1[2] (agriculture requiring 10 times the water a comparable area of urban use would demand). The most agreed upon ratio is close to 2:1. Even though urban land uses require less water, their existence creates a considerable decrease in groundwater percolation because of the increase in impervious area (streets, driveways, buildings, storm drains, etc.) associated with urbanization. Because of this, any flood control effort must consider non-structural alternatives, spreading basins, and soft-bottom channels.

The potential future damages resulting from the urbanization projected for the 100-year future overflow area are great. The potential and the impetus for significant urban growth exists in the study area. Future communities must be protected from flood threats or not allowed to locate in flood threatened areas.

FOOTNOTES

1. Kelso, M. M., Martin, W. E., and Mack, L. E., Water Supplies and Economic Growth in an Arid Environment, The University of Arizona Press, Tucson, Arizona, 1973, page 113.

2. Smith, A. W., Recreational Market Area Study, Tempe, Arizona, 1972, page 7.

TABLE 1

GILA FLOODWAY STUDY AREA LAND USES

Land Use	Present Acreage	Present Percent	Future Acreage	Future Percent	Percent Change
Residential	11,700	19.3	33,000	54.5	+182
Commercial/ Industrial	2,000	3.3	8,300	13.7	+315
Agricultural	45,400	74.9	16,000	26.4	-65
Public	1,500	2.5	3,300	5.4	+120
Total:	60,600	100.0	60,600	100.0	

TABLE 2

GILA FLOODWAY 100-YEAR FUTURE OVERFLOW AREA LAND USE (2030)

(NO FUTURE DEVELOPMENT WITHIN THE 100-YEAR FLOODWAY)

Land Use	Present Acreage	Present Percent	Future Acreage	Future Percent	Percent Change
Residential	1,650	14.2	3,800	32.8	+130
Commercial/ Industrial	150	1.3	400	3.4	+167
Agricultural	9,650	83.2	7,150	61.6	-26
Public	150	1.3	250	2.2	+67
Total:	11,600	100.0	11,600	100.0	

GILA FLOODWAY
PRELIMINARY ENVIRONMENTAL ASSESSMENT
STUDY AREA

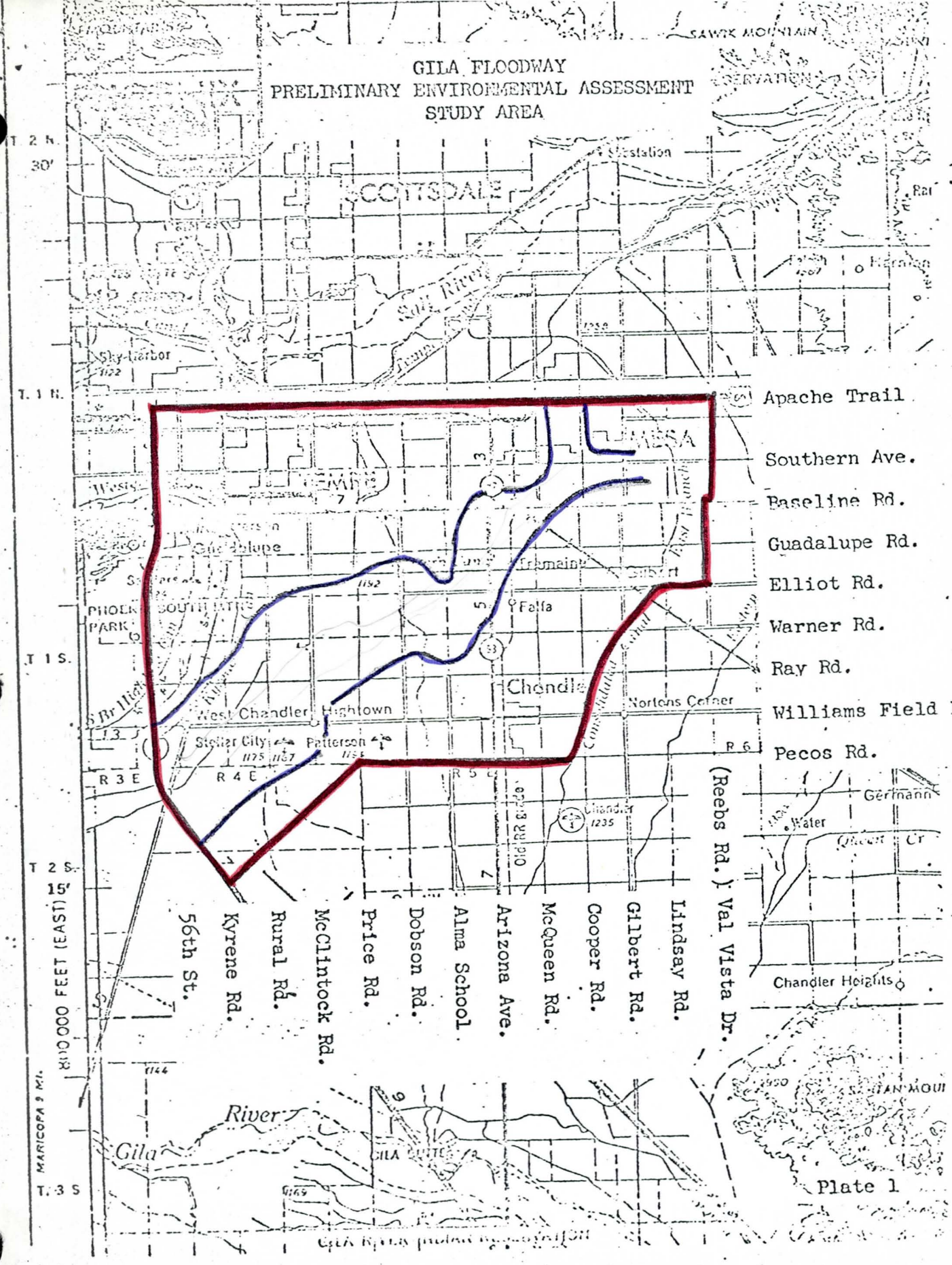


Plate 1

U. S. ARMY ENGINEER DISTRICT

LOS ANGELES

CORPS OF ENGINEERS

PUBLIC MEETING

REGARDING FLOOD CONTROL STUDY

ON GILA FLOODWAY

CHANDLER HIGH SCHOOL AUDITORIUM
150 West Williams Field Road

CHANDLER, ARIZONA

Thursday, 13 December 1973

Chemical
ERASABLE
RAG CONTENT

ALLIED STENOTYPE REPORTERS
By: Don W. Wylie
228 Luhrs Central Building
Phoenix, Arizona 85004

MEMBERS OF THE CORPS OF ENGINEERS PRESENT

Col. John V. Foley, USA, District Engineer,
Los Angeles District.

Maj. Will Worthington, USA,
Phoenix, Arizona.

Mr. Arthur V. Potter, Chief of Project Planning
Los Angeles District.

Mr. Perry Davis, Public Affairs Officer,
Los Angeles District.

Mr. Robert D. Stocking, Project Manager,
Los Angeles District.

Mr. Robert E. Koplin, Hydrologist,
Los Angeles District.

Mr. Maurice Jackson, Civil Engineer,
South Pacific Division.

Mrs. Marie D. Groya
Phoenix, Arizona.

- - -

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Glenlock
PASADENA

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P R O C E E D I N G S

COLONEL FOLEY: Good evening, ladies and gentlemen.

I am Colonel Jack Foley, District Engineer of the Los Angeles District of the U.S. Army Corps of Engineers.

The Los Angeles District is charged with investigation, planning and development of water resources projects in an area which includes Western New Mexico, virtually all of Arizona, sections of Utah and Nevada, and Southern California.

So, you see that despite our district name, we have a continuing interest in flood control and associated problems in Arizona.

This is what brings us here this evening.

We have an on-going congressional authority to study the entire basin of the Gila River and its tributaries. Because of the size of the basin and the various problems found in it, we have been carrying out the study in sections.

This year, at the request of the Board of Supervisors of the Maricopa County Flood Control District, the Congress appropriated money for us to study the flood problems of the area which we are referring to as the Gila Floodway--and which is frequently referred to locally as the Gila Drain.

This is an area of just under 250 square miles--can you all see those? Is there enough light?

(Affirmative responses.)

COLONEL FOLEY: It lies between the Salt River and

and the Gila River, from the South Mountain east to the Roosevelt Water Conservation District Canal.

This is the area under study, but actually we have to look beyond this in our considerations, because water reaches this area from a 760 square mile drainage basin both east and north of the Roosevelt Canal.

I have asked you here this evening to help us with this study. I will go into further detail on the study and how you can help us in a few moments.

First, there are, however, a few administrative details to get out of the way. I'd like first now to introduce some members of my district staff who are here this evening.

Major Will Worthington who is our Representative here in Arizona, and I know many of you know him.

Mr. Art Potter on the right; Mr. Perry Davis on my left, Chief of Public Affairs.

Our Project Engineer, Bob Stocking, here out in the audience, as well as Bob Koplin who is one of our hydrologists. And the very lovely lady, Marie, who is helping us take care of the cards. When you came in, she gave you attendance cards, and I'd appreciate it now, if you have not filled out a card, that you do so at this point and this time, and pass it to the aisle where Marie can pick it up. These cards serve two very useful purposes for us. They give us a

record of who is here and who you represent so that in the future, when we call other meetings or when we have information perhaps to mail to you, we do have a list of people that are interested and have expressed their interest tonight.

And, secondly, on the card you've noticed a place to indicate whether or not you wish to address the group tonight and speak here, or if you prefer to submit a written statement. This helps the meeting run more smoothly. However, please understand that if you hadn't indicated you wanted to speak and you do desire to at some time during the meeting, please do let us know, and we can make provisions for it. Everyone here who wants to be heard will be heard.

We have a stenographer on the left who is keeping a verbatim transcript of this proceeding. Everything that is said here this evening will become an official part of that record. If any of you should want copies of the transcript, you can make individual arrangements with the stenographer to purchase them directly from him.

Now, I'd like to get down to the business of the evening.

This meeting is one of the first steps in our study of the Gila Floodway. We have come here primarily to learn from you. In a study such as this, we need all the help and all the information we can get, and of course, some of the best information and ideas that we can get are from the people

that live here in the local area, and work here.

In a study like this, we must answer basically six fundamental questions.

The first is, we must determine whether there is or is not a problem.

Second, we must find out if there is an engineering solution to the problem.

Third, we must determine if that solution is economically feasible; that is, the return to society over the life of the project must exceed the cost of the project.

Fourth, the solution must be environmentally acceptable--you must have the local support.

Fifth, it must have local support.

And finally, determine if there is a federal interest in participating in solving this problem.

In order for us to recommend any federal participation in a plan, we must have a yes answer to every one of those six questions.

At this point, since we have just started the study, we don't know any of the answers and do not pretend to know the answers. We do know a few things that will affect the study.

As I mentioned earlier, the study area is about 250 square miles, but it receives water from a drainage area of an additional 760 square miles. A study made for Maricopa County by a private engineering firm indicates that in the

case of the so-called 100-year storm, that is, the storm which could occur here on the statistical average of once every 100 years, in this case, water would flow across this area in such an amount as to deliver more than 20,000 cubic feet of water a second to the Gila River. Virtually every drop of water that falls here appears to make its way to the Gila, even though the Salt is one of the boundaries of the study area.

We also know that considerable development is expected here in the future. Right now, there are four clearly defined urban areas in the Gila Floodway, and the total population of the area at this time is about 140,000.

By the year 2020, less than 50 years from now, the best projections we can come up with at this point indicate that the population will number somewhere in the vicinity of 790,000, and urban development will cover approximately 40 percent of this floodway area.

Our problem, then, very simply, is to determine if the floodway need flood protection now or if it will need it in the foreseeable future; and if there is such a need, is there anything we can do about it.

I am looking forward to hearing your opinions on these questions, and, of course, on the associated questions. With that aim in mind, I would like now to stop talking and start listening.

I think as a first order of business, I would like

to call on a representative of the Maricopa County Flood Control District, since it was that district that inspired the study and which will be very active as our partners in the study and in any project that might come from it.

After we have heard from the County, I will turn to these cards that you have submitted and hear from all the rest of you, who have expressed an interest to be heard.

So, at this point, I would like to introduce a gentleman I am sure you all well know, Col. John Lowry, who is--he is Flood Control District Engineer from Maricopa County, and, John, I think you would like to make a statement at this point.

COLONEL LOWRY: Thank you, Colonel. I want to make a brief statement.

The Corps of Engineers and District Engineer has been asked some time ago to make the study that has been authorized by Congress. Funds are being made available; part of the funds are already available.

We, in our studies previously, back as long ago as 1963, saw the need of a flood channel in the area now called the Gila Drain. Since that time, a great deal of development has taken place below Tempe, below Mesa, around Chandler and on the Gila Indian Reservation.

The slope of the land is to the southwest and a great deal or a part of this channel must necessarily cross

the indian reservation.

We have asked and met several times with respresentatives of the reservation people, and we are certainly honored to have with us here tonight Governor Lewis, Governor of the Tribal Council of the Gila Indian Reservation. I'd like for you to meet Governor Lewis.

GOVERNOR LEWIS: (Standing) Thank you.

COLONEL LOWRY: We met with him a couple of weeks ago and got to talking about our problems. We know that the floodwaters are generated in the vicinity of Tempe, Mesa, Chandler and several other of the smaller communities in the area. There is quite a large indian reservation to our south.

They have a great deal of plans themselves for industrial development and urbanization on their reservation, and they, too, will receive benefits from this channel when it is completed.

Colonel, that's about all I had to say on this as to why we thought the study was necessary. We know that damage has occurred many, many times in the past several years, some greater than others, and we hope that you come up with a solution that's found acceptable to the Congress.

COLONEL FOLEY: Thank you very much, Colonel Lowry.

As Colonel Lowry mentioned, Governor Lewis is here, and I think at this point it would be appropriate, Governor,

if you'd care to make a statement.

GOVERNOR LEWIS: If I may, ladies and gentlemen, I do have a statement here which is available to anyone who wants a copy of it.

There is some things that are said in the statement there--but it does contain some of the detailed information about what we are carrying on at the reservation, in that particular area, that we will be discussing about tonight.

We have great things in mind of doing. Plans have been made, studies have been made in the area, projecting development of that particular area. I wish to use the Queen Creek channeling, which takes place soon on our reservation, to take care of the flash floods that come on from the north, onto our reservation. It seems like that all or everything that is bad is thrown onto the reservation. But, in this particular case, I think we may see some of the disadvantages and advantages for us if we can be able to work out a decent plan that will take care of the floods coming down from the Gila Drink.

I would also mention, and I think we should all be aware of it, that in that particular area, compared to the Queen Creek channeling, there hasn't been too much of a development, in order to say that the value of land has gone up in that particular area. In this case, in this particular area for Queen Creek drain, much development has gone into

that particular area, and I feel, and I think my tribesmen would feel the same way, that the value of the land has gone up. It would be a different type of negotiation whenever the time comes because of the increased improvement in that area, speaking about the land.

So, with this in mind, I would like for everyone of you to understand that because of our plans and studies that have been made to improve and develop the land for our own--maybe not our own--personal gain, I think we have provided jobs for our people in that area, provided jobs for people outside the reservation, many of them nonindian and have a lot of them working in the park and that area where there are industries located in that particular area.

So, I think the improvement that has taken place has certainly extended or moved land where it's of more value than it ever has been before. And then again, I do not want any of that land where you can just have a canal and it'll be laying there and maybe a little drop of water goes through there once or twice a year. I think we want to develop it so that we can use the land for higher and better use in the future.

So, we have great things in mind that we want to do or develop the land into, and so I think there has to be a tremendous amount of study made in order to project where can we be able to put a canal or whatever the thing might be

to control the Gila Drain, and the water that comes off from Tempe and so forth.

I would also mention if there is a possiblity where we would be drowned out by diverting all of the water into the Gila River, maybe there's a possibility in the study--maybe portions of it could be diverted to our Salt River bed. Of course, we can say also that if our water table and because of the farming that goes on in our reservation, that the water table has dropped a certain number of peak loads, then maybe the possibility of running this Gila Drain on into the reservation could recharge the underground water to a certain extent. I think this would be a gain to us in that direction.

So, I feel that, as time goes on, we would be able to have some of our people who would be involved and look at the study, the feasibility study of this thing, where it can be laid in so we would be most beneficially using the land for our entire use.

COLONEL FOLEY: Thank you very much, Governor, and I can assure you that we will be working very closely with you on this study.

I would next like to call on Mr. Reid Teeples who is the Associate General Manager of the Salt River Project. I believe he would like to make a statement.

MR. TEEPLES: Yes. I sent you a letter on December 10th. I don't know whether you have it with you or not, but

I would just like to say to you people here, we certainly endorse the Corps study in this specific area. We have been behind this for several years. We have met with the Pima group and all other interested groups in Tempe, Mesa and so forth, several times over the last few years.

So, all I can say this evening is, we heartily endorse your study, and we will cooperate in any way we can.

COLONEL FOLEY: Thank you very much, Mr. Teeples.

I would like now to kind of go into reverse and call on those individuals who really are essentially private citizens representing themselves, and then in reverse order, those of you that might represent local or state or even federal government.

At this point, I think Mr. Dean Sloan, City Engineer, City of Mesa.

MR. SLOAN: Gentlemen, I have just a very short statement, and it's not a statement that I'll submit in writing. Just to keep my remarks short, though, I jotted them down.

The rapid concept or the rapid development that we are experiencing in the southern portion of Mesa is creating potential flooding in that area. We have worked with the Gila Drain concept for several years and the various agencies concerned in the belief that it is the best solution to the problem.

I'll digress here when I say the best solution to the problem--and the Governer of the Gila Bend Agency eluded to the possibility of running water to the Salt Channel. This has been investigated to some extent, and I think that it is an alternate solution, one that would be possible. Legal or political problems involved, or a question raised on that concept is diverting water from one water shed into another water shed. There could be some problems along that line, and we felt that this may be a rather strong factor in favor of the Gila Drain concept,that it actually keeps the water in the water shed and naturally drains at this time.

What we're proposing in this project, if I understand it correctly, is concentrating and controlling the flow of water into the same water shed that it presently falls on.

We wish to be on record as supporting the project, in fact, urge its development as soon as possible. We will soon have a report on the local drainage study--that would be of the Mesa area--which was recently completed by our consultants, and we will furnish copies of this report to the representatives of your agency.

COLONEL FOLEY: Fine. Thank you very much.

I have here Mr. Jim Cooper, who is a Representative from the Legislature, I believe. Mr. Cooper?

REPRESENTATIVE COOPER: I will speak partly for myself, but I think you are aware that the Legislature has been

very much concerned with this problem and last year did institute a 15-year program and started the program with monies to help in some of this. This particular project you're speaking of here isn't one of the ones we did appropriate for but out further east, you are aware of the Salt Foundation and so forth.

The one thing that I have been interested in here in this area, and that I have attended many meetings on, with the City of Mesa and the County Supervisor and so forth is the diverting of the water some way so that the freeway can be built out across there to help the flow of traffic, that is developing out at the east side.

One of the proposals there was that we could run a channel down over long about Dobson Road or somewhere there, down the western canal and then eventually down into the Gila, but I am not sure at this point what you're going on, but I do want you to know, and you know already, that we in the Legislature are concerned.

COLONEL FOLEY: Fine. Thank you, sir.

Again, I'd like to emphasize that we are at a very early stage in this, and we don't have any real plans, but I don't want anybody to be misled that we have a fixation on one particular way of solving this problem. We don't. But there are many solutions and alternatives. So, I appreciate your remarks.

I think next Major Worthington has a statement from the City of Chandler. Is that correct?

MAJOR WORTHINGTON: The City of Chandler is having a meeting themselves tonight, so in the conflict, they handed us this letter and asked that it be read into the record.

Dated December 12, 1973.

"Department of the Army, Los Angeles District, Los Angeles, California.

"Gentlemen: In response to the November 15, 1973 announcement of public meeting for development of information regarding flood control and related purposes, Gila Floodway, Maricopa and Pinal County, Arizona, City of Chandler submits the following statement:

"This past year, in expectation of expanding population growth, the City of Chandler authorized a storm drainage study. The report submitted proposes a plan for control of storm water by retention of rainfall on property, storage of street runoff in detention ponds and transmission of excess storm water through drains to detention basis. Disposal of storm water is by percolation from depressed areas, retention ponds, and detention basins. This plan provides protection for less than a one-year frequency storm.

"Historically the Chandler area has experienced storm water ponding on highways and streets annually. The

depth of ponding impedes vehicular traffic when there is rainfall of 1/2 inch. These areas drain within sixty to ninety minutes after the end of the storm. Incidents of flood damage to private and public property in Chandler to date are reported to have been negligible.

"Designation of floodway routes and priority of construction are important economically to the City of Chandler. Planning for subdivision development is now in progress for some lands through which floodways are proposed. Construction of Gila Drain and Pecos Road Floodways to suitable depth for gravity drains within 5 years would permit coordination with the Chandler plan and eliminate excavation of detention basins for disposal of excess storm water. This action would result in appreciable saving of monies for the City of Chandler.

"The present source of water for the City of Chandler is from the groundwater supply obtained by pumps delivering to the City distribution system. Sewage from the City is conveyed approximately 12 miles west-southwest to a treatment plant located near Lone Butte on the Gila River Indian Reservation.

"Sincerely, Raul G. Navarrette, Mayor."

COLONEL FOLEY: Thank you.

I'd like next to call Mr. Kenneth Fooks.

MR. KENNETH G. FOOKS: Gentlemen, I represent the

City of Chandler on the Hohokam RC&D Project, and I also am a Board Member of the East Maricopa National Resources Conservation District.

I'd like to say this: I have been associated with the thinking of the Gila Drain Project since about 1961. At that time, I was transferred in here as an employee of the Soil Conservation Service. Some time later, we submitted through the board of directors to the Soil Conservation Service the proposal of the Gila Drain Floodway.

Because of the rapid urbanization, it was considered that this was not a soil conservation project. It should be in the category of the Army Engineers.

The whole RC&D Project has then, has asked that the project of the Gila Floodway be removed from the SCS authority and that we highly endorse this Army Engineers' study.

I also would like to emphasize the need for some organized drainage of floodwater from this upper area, as it goes south and west into the Gila Indian Reservation. In the past, people in this area have not considered the damages and the problems that we are having down there.

Reading a report recently made by the reservation people, a statement in there says that there is somewhere around 161,000 acres or about 43% of the Indian Reservation that could be farmed in agriculture. At present, there is

only about half of this amount that is in agriculture at the present time. Mainly, because of the flood problems, that arises from the north, flooding over these lands which is almost impossible to use as agricultural land.

During my tenure at the Soil Conservation Service, a study was made of the land area in Maricopa County. The runoff--the study of desert agriculture areas and then from the same type of land where it had been urbanized, we found that the runoff was somewhere around 300 percent more after urbanization, and it is your statement here that 40 percent of this area will be urbanized in the near future. This is going to cause a tremendous increase in flood runoff.

Also, the waters from the southern part of Tempe and southern Mesa over Gilbert way--there's only one way for it to come and that is south and west. This means that when these cities become more urbanized, as farmland goes into homes, factories or what have you, this is going to raise the extension of runoff to a great degree.

Chandler sits down here at the apex of where the floodwater will run. That's going to be a problem for Chandler in the future.

I think also that now is the time to take care of this problem, as we all know the problems that Phoenix and Scottsdale and in that area are having today. This land is rising in cost more every year.

It stands to reason that this project, if put in force now, before this urbanization takes place all over the area, it could be done cheaper and will also help the cities to know where they should put their floodwater. The problem right now is that many of them--these subdividers, they don't know where to put their water. There's no place for it to go.

So, we need a framework. I'm not saying that this Gila Drain Project should be made laterals and everything else into small sections of land, but the main stems come back in three or four different places from the--what is known as the old Tempe Drain, so that these cities can plan a better control of floodwaters which will rise from this construction and be taken safely down to the Indian Reservation to the Gila River.

Thank you.

COLONEL FOLEY: Thank you very much, Mr. Fooks.

I'd like to call on Mr. C. L. Linser, Chief of Flood Control Planning Branch of the Arizona Water Commission.

MR. C. L. LINSER: Speaking for the Arizona Water Commission, I want to commend the Corps of Engineers for undertaking this study in the area referred to as the Gila Floodway. There is little question that flood control facilities are needed for protection of both urban and agricultural interests in the area.

The only comment I would like to make is relative to the eastern boundary of the study area as shown on the map

attached to the announcement to this meeting. This boundary approximates the location of Consolidated Canal. Flood control facilities now in operation and planned by the Soil Conservation Service under P.L. 566 extend easterly from Roosevelt Water Conservation District (RWCD) Canal. Although these facilities provide, or will provide, protection to the area between the RWCD Canal and Consolidated Canal, further protection should be evaluated. The Soil Conservation Service is not contemplating any facilities in this area. If your current study does not extend easterly to the RWCD Canal, a considerable area subject to flood damage is not receiving consideration for full flood protection.

A study undertaken by Boyle Engineering Corporation and L. H. Bell and Associates, for Maricopa County, estimated that the 100-year storm could generate about 11,000 cfs from this subject area--I'd like to add to my statement that this is not anticipated until the year 2000--I am sure you agree that this would be significant flow. I, therefore, urge you to extend your current planning efforts to include the area between Consolidated Canal and the RWCD Canal.

I would also like to mention that if a feasible project is formulated, and subsequently authorized and funds appropriated, the State, through the Arizona Water Commission, will financially assist the local sponsor by reimbursing up to one-half the necessary costs of lands, easements, rights-of-way,

and relocations necessary for the project.

COLONEL FOLEY: Thank you very much, Mr. Linser, and I might add that you are absolutely correct. There is an error on the information sheet, and it does go easterly to the RWCD Canal. Thank you very much for pointing that out.

I have--the next gentleman has a question mark, a Mr. Richard Moore, with the Arizona Bureau of Mines.

MR. RICHARD MOORE: Yes. I came here, not knowing exactly how far your study had gone and in the hopes of getting some information.

That not being the case, I would like to make a plea that your study should include what effect this might have on salinity problems in the area. I do think that the soils in the area do have a fairly high salinity and natural floods are one way of flushing the salt off of soil and just what effect it would have on agricultural and such.

COLONEL FOLEY: Thank you very much.

Next, I have another one with a question mark. Chris Williams.

MR. CHRIS WILLIAMS: No thank you.

COLONEL FOLEY: All right. Thank you.

There's no indication on these. Mr. C. Farrington?

MR. FARRINGTON: No, sir, thank you.

COLONEL FOLEY: Mr. Grover Serenbetz?

MR. GROVER SERENBETZ: Yes, sir, I'd like to make a

comment.

COLONEL FOLEY: Please.

MR. SERENBETZ: My name is Grover Serenbetz. I am Public Works Director for the City of Tempe. I hadn't planned to submit anything in writing this evening, but I would like to just add to what has been said, and I'll attempt not to repeat what has been stated by others.

I think that it's extremely important that you do proceed very expeditiously with any study that you might make. We find that we already are expanding very rapidly to the south into the area, into the northern part of this water shed, and we are doing everything we can to--to detain and retain our runoffs, but by the time anything is concluded we will probably be well developed. We will be subject to some flooding certainly, but, however, we will be contributing to the area to the south of us, I'm sure, at that time.

We had hoped, some years ago, that we would be able to know what the alignment might be for the floodway and any major stems so that we might, in our subdivision planning, set aside these lands or at least be able to keep development out of their particular path or route, but we have not been able to do that because we do not know just where this might be located, and if it is located, we do not know how wide, so we are somewhat helpless at this point.

What I am saying is not new to those that I have

worked with in the Corps and also NCS, but I think I would like to repeat it for the record that we certainly do want to cooperate, and we find at this point our hands are somewhat tied in not knowing just how we can cooperate, but we mean to do everything we can to hold as much water within our own community.

The 18-hole golf course which is under construction right today, we are retaining 100-year flows from a sizeable area, and by some late development within the golf course--we are--have required all developments south of the western line to develop their properties to not only to detain but to retain all the water they can hold on their property as well as their local collector streets and the water that falls under major arterial streets will have to go somewhere. We have Motorola coming into the city now, south of the western canal, we are developing 160 acres in an industrial area. We have told them they are going to have to retain all their surface water. They are redesigning their development so this will be accomplished, as we were saying, over the 100-year storms. These people are not real happy when they first hear about this, but when they find that there is no alternative, and that this will also help protect their development, then they certainly are doing this.

But, we are convinced we are going to have some problems, and we are willing to share in solving these, but

we would like to encourage your rapid movement on this if it is at all possible.

COLONEL FOLEY: Fine. Thank you very much sir.

I might add that we have very limited funds that we're starting with now. We hope to accelerate this after the president's budget next January, so we are really at the first stages of the planning of this. I would hope that the next time--we'll have many meetings in between, perhaps on an informal basis where I'm sure, you know, you'll be able to be very directly involved, but perhaps the next formal public meeting, we'll have it when we can present alternatives that I know you're interested in hearing as soon as possible. Hopefully, this will be an array of solutions that we will be able to perhaps zero in on those that are more desirable. We're really not there yet.

I do not have any other cards. Is there anyone that--is there anyone that might have views they would like to present? Does anyone have any questions?

REPRESENTATIVE COOPER: May I make another comment?

COLONEL FOLEY: Yes, sir.

REPRESENTATIVE COOPER: I didn't know what the nature of your meeting was at all, but I came kind of unprepared. I have been very much involved in this subject ever since I've been in the Legislature, and I have attended many meetings, and I've heard some comments made about diverting

some of this water back into the Salt, and I've attended meetings where this has come up. Of course, the City of Mesa especially has been interested in this, because I mentioned while ago the freeway--we would like to see that freeway extended so we can get into Phoenix easier, which I have to drive every day. But, it was found that you really have to go through quite a hump to get to the area where the water is along Southern Avenue and that area back to the Salt River.

Also, the last meeting I attended, it was discussed taking some of the water from the drainage down by Williamsfield to their back end of the Salt up east and on north of Mesa, and immediately people in Phoenix started hollering, we have all the water in the Salt we want.

Now, this isn't always true, but after last spring, it was very much on their minds in Tempe and Phoenix initially started saying we don't want any of that water put back in there. So, these are some of the things that I've heard in the meetings that I've attended, and I'd certainly like to be kept abreast of what's going on, and be able to listen to your proposals and see how they work out.

COLONEL FOLEY: Very fine sir. That's Mr. Cooper, isn't it?

Now, I can assure you we will research what has been done already on this, and I'm sure, Bob, you've already begun doing that, and he'll be spending many months out here so we -

don't plow any ground that's already been plowed, and I don't want to have to do that, but that's the very kind of thing that would help us accelerate this. There has been a lot of preliminary study made in this area already.

Well, I don't want to keep anyone unless thay have something else to add. This is really a fact-finding meeting. We want to get on with it, and we did want to hear just how strongly you all felt and what kind of approaches you felt were necessary to be looked at.

I'm sure that there will be other alternatives which we haven't even mentioned here tonight that will enter into our study, because they will surface themselves, although perhaps not here tonight.

I assure you that we will keep you informed, as you asked, Mr. Cooper, as we make some progress here. We want to have all those that have an interest involved early so that we don't get any surprises at the end of the road here when we think we've got something ready to go and suddenly get turned around backwards. We do want to preclude that happening in this case.

I'd like, at this point, unless someone has something further--I think at this point I will thank John and all the people that were kind enough to have us down here and give us this fine facility, which I'm truly impressed with. This is quite a high school here in Chandler.

I appreciate your help, and I look forward to hearing from you, and I will promise to keep you informed as we develop some of these alternatives.

OK, ladies and gentlemen, I think the meeting can be adjourned.

(Whereupon, at 8:35 p.m., the public hearing in the above-entitled matter was adjourned.)

* * *

ERASABLE
RAG CONTENT

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
6029 Federal Building, 230 North First Avenue, Phoenix, Arizona 85025

December 16, 1975

Mr. Garth A. Fuquay
Chief, Engineering Division
U.S. Army, Los Angeles District,
Corps of Engineers
P.O. Box 2711
Los Angeles, California 90053

Dear Mr. Fuquay:

We appreciate having had the opportunity to review the "Gila Floodway Survey Report, Hydrology, Part I," and offer the following comments for your consideration:

From our review, it appears that although the methodology as used by the SCS and the Corps of Engineers in evaluating the runoff potential of the study area differs considerably, comparable results have been obtained. This can be attributed in part to the continuous coordination efforts conducted by our staffs. Areas of general agreement include: present and projected land use, percent impervious by type and density of urbanization, velocity of overland flows, volume of depression storage on agricultural lands, and the effect of existing and proposed SCS projects on the runoff potential for the study area.

The only significant difference in our evaluations is in the treatment of onsite storage. We have reached agreement with the Maricopa County Flood Control District that one-inch of onsite storage will be required for all new land developed after 1975 for the area between the existing and proposed SCS floodwater retarding structures and the proposed RWCD Floodway. This requirement has been included as part of the Supplemental Work Plan Agreement for the Buckhorn-Mesa Watershed Project.

The only other comment with respect to the subject report is referenced to page 2, paragraph 2, of the HEC Special Project Memo No. 441, dated August 29, 1975. In this paragraph the statement is made that the relationship $K=0.5t_c$ "bears similarity to another relationship used in Soil Conservation procedures $tp=0.6t_c$." The equation $tp=0.6t_c$ is incorrect; but in conversation with Mr. John Pederson of your staff, it appears that the error is simply in the misuse of SCS standard symbols.

The SCS uses the symbol "tp" to refer to the "time to peak" of the runoff hydrograph and "L" is used to symbolize "basin lag," i.e. $L=0.6t_c$. Basin lag (L) as defined by SCS is the time from center of mass of excess rainfall to the peak rate of runoff and is similar to the definition of "K" as defined in your report. Additional definition and description of relationships and symbols used by SCS in hydrologic analysis can be found in Chapters 15 and 16, Section 4, Hydrology of the SCS-NEH.

We hope that these comments will be of benefit to you; and if we can be of further assistance, please let us know.

Sincerely,

Thomas G. Rockenbaugh
State Conservationist

cc: Herbert Donald, Maricopa County
Flood Control District

7/15/77
RY

AGRICULTURE @ $300/ACRE VALUE

MESA, NORTH of FWY

				SAH
EXISTING SPF	1455 ACRES	x $300 =	436500	435000
	1363	" =	408900	410000
	1026	" =	307800	305000
	180 ACRES IN 100 yr	x $300 =	5400	55000

TEMPE

~~SPF 467 ACRES x $300 = 140100 140000~~

467 acres shown in Agric. Rpt should have been labeled VACANT

DOBSON RANCH Vic.

SPF	788 ACRES	x $300 =	236400	235000
	128 ACRES	x $300 =	38400	40000

Gila Floodway
Damages to Industrial Park

.2" 7 acres bldg. · 288,000 sq-ft
1" 35 acres

Bldg @ $13.00/sq ft Good "D"
Contents @ $1500/sq-ft

Bldg	=	3,744,000	.54'	100yr
Cont	=	4,320,000	1.24	SPF (.02)

Bldg. about .5' above ground

	Damage Struc	Cont	Total
SPF (	75000	390000	465000
100yr	—	50000	50000
			Say 500000

Annual

.002 x 465,000 =	1,000
(.01 - .002) x ($\frac{465000+50000}{2}$) =	2,000
Total	3,000

Value = 8,064,000

10:00
8:15

Benefits from alternatives – Gila Floodway
(6⅛% – 100 years)

Alternative 1 SPF Channels

Equivalent Annual Benefits

Existing	Future
$ 94,000	$ 294,000

Alternative 2 100 yr Channel

Existing	Future
$ 7,000	
say 10,000	$ 15,000

Alternative 3 100 yr – Gilbert

Existing	Future
$ 7,000	$ 8,000

Alternative 4 100 yr – Chandler

Existing	Future
$ 18,000	$ 22,000

Alternative 5 SPF, North Side of Fwy

Existing	Future
$ 33,000	$ 86,000

2 58

5A Reduce drainage 50%
Assume 50% effective on Main Floodway

SPF

Existing	Future
$ 90,000	$ 234,000

Alternative 6 ? Not Quantified

122

Estimated Present (1975) and Projected Damages for SPF, 100-year, 50-year, and 25-year Floods
($1000's)

	Present	Projected					
	(1975)	1979	1989	1999	2009	2019	2029	2079
North Bank of Proposed Superstition Freeway								
SPF	2969	4223	9016	20930	21546	21546	21546	21546
100-year	234	243	271	295	295	295	295	295
50-year	0	0	0	0	0	0	0	0
25-year	0	0	0	0	0	0	0	0
Breakout in Tempe								
SPF	8187	11538	12826	13964	13964	13964	13964	13964
100-year	0	0	0	0	0	0	0	0
50-year	0	0	0	0	0	0	0	0
25-year	0	0	0	0	0	0	0	0
Gilbert								
SPF	1058	1097	1214	1329	1329	1329	1329	1329
100-year	346	357	393	423	423	423	423	423
50-year	71	73	80	87	87	87	87	87
25-year	39	41	44	48	48	48	48	48
Chandler East of SPRR								
SPF	2975	3074	3374	3648	3660	3660	3660	3660
100-year	195	199	259	324	376	435	520	520
50-year	0	0	0	0	81	165	249	249
25-year	0	0	0	0	0	8	124	124

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Estimated Present (1975) and Projected Damages for SPF, 100-year, 50-year, and 25-year Floods
($1000's)

	Present (1975)	Projected 1979	1989	1999	2009	2019	2029	2079
Chandler West of SPRR								
SPF	5029	5227	5830	6363	6363	6363	6363	6363
100-year	0	0	0	0	0	0	0	0
50-year	0	0	0	0	0	0	0	0
25-year	0	0	0	0	0	0	0	0
Gila Drain								
SPF	1,077	1,077	35375	40922	41443	41443	41443	41,443
100-year	100	100	100	100	100	100	100	100
50-year	0	0	0	0	0	0	0	0
25-year	0	0	0	0	0	0	0	0
Dobson Ranch Vicinity								
SPF	4475	8077	9963	11142	11563	11983	12404	12404
100-year	0	0	0	0	0	0	0	0
50-year	0	0	0	0	0	0	0	0
25-year	0	0	0	0	0	0	0	0
Ponding at Center St. and SPRR								
SPF	309	312	315	2,432	2,562	2,562	2,562	2,562
100-year	89	89	110	474	696	897	1,097	1,097
50 year	25	25	47	70	92	309	536	536
25 year	0	0	19	40	63	86	256	256
SUMMARY TOTAL (ALL Reaches)								
SPF	26,078	34,625	77,913	100,730	102,430	102,850	103,271	103,271
100-year	964	988	1,133	1,616	1,898	2150	2,435	2,435
50-year	96	98	127	157	260	561	872	872
25-year	39	41	63	88	111	142	428	428

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Table 3

Present (1975) and Projected Development by Type of Development for ~~the~~ Standard Project Flood

(Acres)

North Bank of Proposed Superstition Freeway

	1975		1979		1989		1999		2079	
	55ØØcfs*	1Øcfs*	55ØØcfs*	1Øcfs*	55ØØcfs*	1Øcfs*	55ØØcfs*	1Øcfs*	55ØØcfs*	1Øcfs*
Residential	235	35	327	35	664	35	1690	35	1690	35
Trailer Parks	24	Ø	24	Ø	24	Ø	24	Ø	24	Ø
Public	121	Ø	121	Ø	121	Ø	121	Ø	121	Ø
Agriculture	1455	Ø	1363	Ø	1026	Ø	Ø	Ø	Ø	Ø
Total	1835	35	1835	35	1835	35	1835	35	1835	35

* Location: Mesa Tempe Reach 3-1.

Breakout in Tempe

	4ØØØcfs	Øcfs	4ØØØcfs	Øcfs	4ØØØcfs	Øcfs	4ØØØcfs	Øcfs	4ØØØcfs	Øcfs
Residential	1578	Ø	2Ø45	Ø	2Ø45	Ø	2Ø45	Ø	2Ø45	Ø
Commercial	45	Ø	45	Ø	45	Ø	45	Ø	45	Ø
Public	114	Ø	114	Ø	114	Ø	114	Ø	114	Ø
Agriculture	467	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø
Total	2204	Ø	2204	Ø	2204	Ø	2204	Ø	2204	Ø

Gilbert

	4ØØØcfs*	62Øcfs*	4ØØØcfs*	62Øcfs*	4ØØØcfs*	62Øcfs*	4ØØØcfs*	62Øcfs*	4ØØØcfs*	62Øcfs*
Residential	71	49	71	49	71	49	571	49	571	49
Trailer Parks	2	2	2	2	2	2	2	2	2	2
Commercial	24	16	24	16	24	16	24	16	24	16
Public	1	1	1	1	1	1	1	1	1	1
AGRICULTURE	3550		3550		3550		3050		3050	
Total	3648	68	3648	68	3648	68	3648	68	3648	68

* Location: Gilbert Reach 1

Chandler

Residential	761	Ø	761	Ø	761	Ø	761	Ø	761	Ø
Trailer Parks	1Ø	Ø	1Ø	Ø	1Ø	Ø	1Ø	Ø	1Ø	Ø
Commercial	1Ø9	Ø	1Ø9	Ø	1Ø9	Ø	1Ø9	Ø	1Ø9	Ø
Public	1Ø3	Ø	1Ø3	Ø	1Ø3	Ø	1Ø3	Ø	1Ø3	Ø
Total	983	Ø	983	Ø	983	Ø	983	Ø	983	Ø

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Table 3 (cont'd) Present (1975) and Projected Development by Type of Development ~~for Various Sized Floods~~ within SPF Flood Area

(Acres)

Chandler East of SPRR

	1975		1979		1989		1999		2079	
	46ØAc-ft	31ØAc-ft	46ØAc-ft	31ØAc-ft	46ØAc-ft	31ØAc-ft	46ØAc-ft	31ØAc-ft	46ØAc-ft	31ØAc-ft
Residential	94	53	94	53	94	53	94	53	94	53
Trailer Park	1Ø	1Ø	1Ø	1Ø	1Ø	1Ø	1Ø	1Ø	1Ø	1Ø
Commercial	89	89	89	89	89	89	89	89	89	89
Total	193	152	193	152	193	152	193	152	193	152

Chandler West of SPRR

	5ØØØcfs	Ø cfs	5ØØØcfs	Ø cfs	5ØØØcfs	Ø cfs	5ØØØcfs	Ø cfs	5ØØØcfs	Ø cfs
Residential	667	Ø	667	Ø	667	Ø	667	Ø	667	Ø
Commercial	7Ø	Ø	7Ø	Ø	7Ø	Ø	7Ø	Ø	7Ø	Ø
Public	1Ø3	Ø	1Ø3	Ø	1Ø3	Ø	1Ø3	Ø	1Ø3	Ø
Total	84Ø	Ø	84Ø	Ø	84Ø	Ø	84Ø	Ø	84Ø	Ø

Gila Drain

	19ØØØcfs	25ØØcfs	19ØØØcfs	25ØØcfs	19ØØØcfs	25ØØcfs	19ØØØcfs	25ØØcfs	19ØØØcfs	25ØØcfs
Residential	Ø	Ø	Ø	Ø	2Ø39	Ø	2Ø39	Ø	2Ø39	Ø
Industrial	35	35	35	35	35	35	35	35	35	35
Agriculture	2Ø39	872	2Ø39	Ø	Ø	Ø	Ø	Ø	Ø	Ø
Total	2Ø74	907	2Ø74	35	2Ø74	35	2Ø74	35	2Ø74	35

EXCLUDE

Ponding at Center Street and SPRR

	610Ac-Ft	214Ac-Ft	103Ac-Ft	610Ac-Ft	214Ac-Ft	103Ac-Ft	610Ac-Ft	214Ac-Ft	103Ac-Ft	610Ac-Ft	214Ac-Ft	103Ac-Ft	610Ac-Ft	214Ac-Ft	103Ac-Ft
Residential	59	33	0	59	33	0	59	33	0	185	33	0	185	33	0
Commercial	45	36	0	45	36	0	45	36	0	45	36	0	45	36	0
Agriculture	819	447	128	819	447	128	819	447	128	693	447	128	693	447	128
~~Total~~															

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Table 3 (cont'd)

Present (1975) and Projected Development by Type of Development for Various Sized Floods (Acres)

Dobson Ranch Vicinity

	1975		1979		1984		1999		2079	
	4300 cfs	ϕ cfs	4300 cfs	ϕ cfs	4300 cfs	ϕ cfs	4300 cfs	ϕ cfs	4300 cfs	ϕ cfs
Residential	858	ϕ	1518	ϕ	1646	ϕ	1646	ϕ	1646	ϕ
Golf Courses	110	ϕ	110	ϕ	110	ϕ	110	ϕ	110	ϕ
Agriculture	788	ϕ	128	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ
Total	1756	ϕ	1756	ϕ	1756	ϕ	1756	ϕ	1756	ϕ

Ponding at Center Street and SPRR

	610 Ac-ft	214 Ac-ft	103 Ac-ft	610 Ac-ft	214 Ac-ft	103 Ac-ft	610 Ac-ft	214 Ac-ft	103 Ac-ft	610 Ac-ft	214 Ac-ft	103 Ac-ft	610 Ac-ft	214 Ac-ft	103 Ac-ft
Residential	59	33	0	59	33	0	185	33	0	185	33	0	185	33	0
Commercial	45	36	0	45	36	0	45	36	0	45	36	0	45	36	0
Agriculture	819	447	148	819	447	148	693	447	148	693	447	148	693	447	148
Total	923	516	148	923	516	148	923	516	148	923	516	148	923	516	148

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Gila Floodway - Acres in SPF

	Total	Develop-
North Bank - Superstition (Mesa)	1835	380
Mesa - Tempe (Tempe)	2204	1737
Ponding	923	104
Dobson Ranch	1756	968
Gilbert (Revise (see Ron) F)	3648	98
Chandler		
Ponding	193	193
Overflow	840	840
Main Floodway	2074	35

2204
-467
737

983
98

2750 Ac.
$825000

AC 3663
$ 1098900

SUBJECT	Estimated Present (1975) Value of Development and Damages by Property Type for Various Sized Floods ($1000's)	DATE 12/17/75	PAGE OF PAGES
SOURCE OF DATA			
COMPUTED BY	CHECKED BY	SECTION	

Land Use	Value of Development			Damages		
	North Bank of Proposed Superstition Freeway					
	5500 cfs*	10 cfs*	0 cfs*	5500 cfs*	10 cfs*	0 cfs*
Residential Structures	20807	3,106	0	1505	155	0
Contents	8738	1,304	0	1168	78	0
Trailer Park	810	0	0	38	0	0
Public	8806	0	0	258	0	0
Total	39161	4,410	0	2969	233	0
*Location: Mesa Tempe Reach 3-1.						
	Breakout in Tempe					
	4000 cfs	0 cfs	0 cfs	4000 cfs	0 cfs	0 cfs
Residential Structures	10402	0	0	4267	0	0
Residential Contents	42589	0	0	2513	0	0
Commercial	42253	0	0	1263	0	0
Public	10254	0	0	144	0	0
Total	196498	0	0	8187	0	0
	Gilbert					
	4000 cfs*	620 cfs*	100 cfs*	4000 cfs*	620 cfs*	100 cfs*
Residential Structures	3369	2359	887	384	141	45
Residential Contents	1415	991	373	322	97	20
Trailer Parks	106	106	0	28	11	0
Commercial	2477	1718	432	301	81	6
Public	284	284	0	23	16	0
AG	240 1065	90	0	0	0	0
Total	~~8716~~	~~5158~~	~~1692~~	1058	346	71
*Location: Gilbert Reach 1						

SUBJECT Estimated Present (1975) Value of Development and Damages by Property Type for Various Sized Floods ($1000's)

DATE

PAGE OF PAGES

SOURCE OF DATA

COMPUTED BY

CHECKED BY

SECTION

	Value of Development			Damages		
Chandler East of SPRR						
	460 Ac-ft	310 Ac-ft	235 Ac-ft	460 Ac-ft	310 Ac-ft	235 Ac-ft
Residential Structures	7280	4030	3172	924	242	159
Residential Contents	3057	1693	1332	786	152	60
Trailer Parks	1079	1079	1012	228	46	24
Commercial	10366	10366	8416	1037	365	118
Total	21782	17168	13932	2975	805	361
Chandler West of SPRR						
	5000 cfs	0 cfs		5000 cfs	0 cfs	
Residential Structures	42302	0		2597	0	
Residential Contents	17767	0		1698	0	
Commercial	7162	0		259	0	
Public	16543	0		474	0	
Total	83774	0		5028	0	
Gila Drain						
	19000 cfs	25000 cfs	0 cfs	19000 cfs	25000 cfs	0 cfs
Residential Structures	0	0	0	0	0	0
Residential Contents	0	0	0	0	0	0
Industrial	8064	8064				
Agriculture	612	261	0	612	0	0
Total	~~612~~ 0676	~~261~~ 8325	0	612	0	0

WES FORM NO. 1114
JANUARY 1961

SUBJECT Estimated Present (1975) Value of Development and Damages by Property Type for Various Sized Floods ($1000's)

DATE

PAGE OF PAGES

SOURCE OF DATA

COMPUTED BY

CHECKED BY

SECTION

	Value of Development			Damages	
	Dobson Ranch Vicinity				
	43∅∅cfs	∅ cfs		43∅∅cfs	∅ cfs
Residential Structures	78∅91	∅		39∅5	∅
Residential Contents	32798	∅		1476	∅
Golf Courses	3∅6	∅		7	∅
Total	111195	∅		5388	∅
	Ponding at Center Street and SPRR				
	610 Ac-ft	214 Ac-ft	103 Ac-Ft	610 Ac-ft	214 Ac-Ft	103 Ac-Ft
RESIDENTIAL Structures	225	165	0	33	10	0
Residential Contents	94	69	0	28	7	0
Commercial	900	720	0	33	15	0
Agriculture	215	143	38	215	57	25
Total	1434	1097	38	309	89	25

WES FORM NO. 1114
JANUARY 1961

Gilbert agriculture

100 year pres value

50 year pres value

Pres	acres - Ag		Value
SPF	800 acres		
100 yr	300 acres		90000
50 yr			

FLOOD CONTROL DISTRICT of Maricopa County

3325 West Durango Street • Phoenix, Arizona 85009 • Telephone (602) 262-3630/262-3639

December 3, 1975

Department of the Army
Los Angeles District, Corps of Engineers
P. O. Box 2711
Los Angeles, California 90053

ATTENTION: Colonel John V. Foley

RE: Gila Floodway - Maricopa and Pinal Counties, Arizona

Dear Colonel Foley:

On November 19, 1975, Mr. Leland Anderson, Project Engineer for the referenced Corps study presented preliminary findings regarding hydrologic and economic evaluation of a flood control project for the watershed. The preliminary conclusions of the study were discussed among the seven local agencies represented at that meeting. A number of comments were elicited concerning conclusions reached by the Corps. Mr. Anderson agreed to consider a number of the comments and requested that further comments be forwarded as soon as possible. Our comments are as follows:

The flood control facilities assumed for the Corps' economic analysis include a floodway from Williams Field Road to the Gila River along the alignment of existing Salt River Project (SRP) Gila Drain and tributary drainage channels from Chandler along Williams Field Road and from Mesa and Gilbert along the Western Canal. Also provided would be a disposal point for the City of Mesa - Arizona Department of Transportation (ADOT) drainage system proposed along the Superstition Freeway alignment. Benefits were estimated to be $2.5 million for a 100-year flood with cost of the system estimated at $25 million.

We would like to propose consideration of a number of factors as benefits which were not included in the economic analysis.

1. The Mesa-ADOT drainage system was designed assuming an outlet to the Gila Floodway. At this time there is no outlet. The drainage basins will retain water until it dissipates by seepage and evaporation, very likely for the duration of entire "monsoon" season. The cumulative effect of a series of moderate storms could cause considerable damage currently not considered. We feel that significant economic benefit should be attributed to draining the Mesa-ADOT

system from both standpoints of flood protection and public health.

2. The Mesa-ADOT system provides almost 100% of the drainage necessary for the Superstition Freeway between the Tempe Canal and the Roosevelt Water Conservation District Canal, approximately 10 miles. Because the Mesa-ADOT system was designed assuming an outlet to the Gila Drain, the feasibility of continued construction of the freeway may depend on establishing adequate disposal capability for the system. The net benefits of the freeway should be considered as an economic factor in the Gila Floodway analysis.

3. Determination of overflow areas in the study was made on the basis of the latest USGS topography available. In many cases, this topography does not reflect land development within the last several years. It has been pointed out by the City of Mesa that the area between the Tempe Canal and Country Club Drive from the Western Canal to Broadway Road has been developed through the importation of large amounts of fill material from outside this area. The result is that the volume of storm water ponded by the Western and Tempe canals in a 100-year storm would be significantly less than that estimated in the study. Consideration of this factor in the study should result in increased damages from the 100-year storm, therefore, increased benefits.

4. During storms in the Mesa area a considerable amount of surface drainage is introduced into the SRP canal system. Currently the only relief for SRP from the Tempe-Western Canal system within the Gila Drainage area boundary is a 75 cfs release to the existing Gila Drain. Although the precise point (s) at which a 100-year storm would breach the Tempe or Western Canal cannot be determined, there is an obvious, but undefined, benefit to providing increased spill capacity from the Western Canal to the Gila Drain.

It was pointed out by Mr. Anderson that the value of all right-of-way, whether purchased, or donated, was included as a cost to the project. An exception would be existing right-of-way for flood control. The existing SRP right-of-way for the Gila Drain has been used for many years for emergency storm releases. If this land were made available at no cost by SRP, the value of the right-of-way should not be considered as a project cost.

Our review of the preliminary hydrology survey report has resulted in no additional comments other than the possibility of updating development in overflow areas per Item 3 above.

It is our understanding that the report forthcoming on the Gila Floodway will recommend whether to continue or abandon the study. It is our recommendation that the study be continued to determine whether any

of the components of the Gila drainage system would result in a feasible project when considered separately, i. e. drainage of Chandler, emergency release from the Western Canal, outlet capacity for the Mesa-ADOT system, drainage of Gilbert.

We will appreciate your consideration of all of the above factors and will be happy to assist you in any way possible.

Sincerely,

Herbert Donald by J. Leavitt

Herbert P. Donald, P. E.
Chief Engineer and General Manager

HPD/BJ/det

cc: Don Womack, SRP
Dean Sloan, Mesa
Martin Toney, ADOT
Omar Rood, Gilbert
Grover Serenbetz, Tempe
Charlie Johnson, Chandler

SPKHE

29 August 1975

SPECIAL PROJECTS MEMO NO. 441

SUBJECT: Review of Rainfall-Runoff Model for Use in Sheet Flow Areas

1. References:

   a. SPLED-HE 25 June 1975, Subject: Request for Review and Evaluation of Rainfall-Runoff Model for Use in Sheet Flow Areas.

   b. Letter SPKHE 14 July 1975 to Chief, Engineering Division, Los Angeles District.

2. The subject review was requested by the Los Angeles District in reference a. Reference b suggested arrangements for the review, including the holding of a meeting at HEC to discuss the technical bases for the subject model. Messrs. John Pederson and Daniel Norling of the Los Angeles District met with Messrs. Dale Burnett, Arthur Pabst and John Peters at HEC on 19 August 1975. The following paragraphs contain the HEC's review comments based on that meeting and on subsequent review of written material pertaining to the subject model.

3. The rainfall-runoff problem that required modeling for the Mesa, Arizona Flood Insurance Study and Gila Floodway Study is indeed complex. Runoff is expected to occur as sheet flow; that is, runoff will spread over broad planar surfaces rather than concentrate in well-defined channels. There are a number of obstructions to the flow in the form of low, uncompacted levees on the upstream sides of irrigation canals which traverse the area. These levees are certain to fail when overtopped, but yet the temporary impoundment of runoff caused by these levees and intersecting roadway embankments cannot be ignored. Portions of the drainage area have undergone substantial urban development.

4. A basic element of the subject rainfall-runoff model is application of the concept of the single linear reservoir for transforming rainfall excess to runoff. Studies at Purdue University and elsewhere have demonstrated that this concept is appropriate and useful for small drainage areas (e.g. less than 5 sq. miles) and we concur with its application.

5. Application of the linear reservoir procedure requires evaluation of a parameter K which represents the slope of a linear relationship between outflow and storage. The parameter K can be shown to be equal to the time interval between the centers of mass of rainfall excess and direct runoff. In the case where the runoff process is linear, as assumed in unit hydrograph theory, this time interval is independent of both intensity

and duration of rainfall excess. In the proposed method, K is assumed to equal 50% of the time of concentration, where time of concentration is defined by an equation by Ragan and Duru as a function of length, slope, roughness and intensity of effective rainfall.

6. The derivation of the relationship between K and t_c (i.e. K = 0.5 t_c) is subject to question. The steps leading to this relationship are valid only under certain conditions. The time of concentration, t_c is always less than the time to equilibrium, t_e (or 97% of the time to equilibrium, t_{97}). The larger the amount of storage in a watershed (or runoff plane), the greater will be the difference between t_c and t_{97}. The t_c may be taken to be analogous to t_{97} only where surface storage (detention storage in the flow profile) is quickly satisfied. The conclusion that the time to peak may be used to approximate the time to the center of mass as implied in Plate 17 is valid only when the hydrograph is symmetrical about the peak. Thus the derived relationship may not be valid in general. The relationship bears similarity to another relationship used in Soil Conservation Service procedures - t_p = 0.6 t_c. Because K is typically greater than t_p, it seems that K could be expected to be a larger proportion of t_c than 50%. However, successful reproduction of observed events affirms the useability of the relationship. It would be desirable to determine the sensitivity of the final results to various changes in K. This would provide a basis for judging whether a need exists for a more refined relationship.

7. Application of the equation for t_c by Ragan and Duru requires that rainfall intensity be specified. The equation is based on a condition of constant rainfall intensity. To apply the equation to storm rainfall of varying intensity, an assumption must be made as to what rainfall intensity to use. In the subject procedure, the maximum 15-minute rainfall intensity was adopted.

8. The equation for t_c by Ragan and Duru also requires that a roughness coefficient, n, be specified. A problem exists in selecting n values, and in establishing composite n-values for non-homogeneous areas. For example, n values could be weighted in accordance with the size of area to which they apply, or criteria such as the inverse weighting relationship recommended for use in the EPA Storm Water Management Model could be used. The latter criteria was adopted for calibration purposes.

9. Because of the assumptions discussed in the preceding paragraphs, the desirability of verifying the adopted procedures against field data is apparent. The verifications on data for the El Modena-Irvine channel and Aqua Fria tributary are certainly encouraging, but it is hoped that additional verification can be made in the future.

10. Once runoff from subareas has been computed, assumptions are required with respect to ponding behind, and failure of, levees. The procedure for

estimating depth-volume characteristics of ponding areas appears to be adequate and appropriate. Assumptions implicit in modeling levee breaks are that the levees will not fail until they are overtopped, the water surface behind the levee will not exceed the top of levee elevation, and discharge from dead storage behind the breeched levee will be in proportion to the 'inflow' hydrograph to the ponded area. The latter assumption is somewhat tenuous but should be adequate provided that release from dead storage is not the major portion of flow through the levee.

11. Muskingum routing criteria adopted for the study assumes a constant velocity of flood wave travel of 1.5 feet per second and an X of 0. Because of the changing ground slope through the study area, it might be more appropriate to vary the velocity with the square root of slope. However, because of the uncertainties regarding the paths that the flow will follow, the adopted criteria are reasonable.

12. In summary, the subject model is logical, reasonable and appropriate for the problem being modeled. The complexity of the problem requires numerous assumptions, some of which are commented on above. No runoff data are available in the study area. The results of application of the model would appear to yield a reasonable assessment of the hydrologic behavior of the area modeled. As additional data become available it would be desirable to reevaluate model results and further validate the procedures used.

John C. Peters

JOHN C. PETERS, Chief
Training and Methods Branch
The Hydrologic Engineering Center

Bill S. Eichert

BILL S. EICHERT, Director
The Hydrologic Engineering Center

opy furnished:
Chief, Engineering Divison
Los Angeles District

Mesa - Tempe (N. Side of Canal)
100 yr

Use 1999

.2	.65	1	1.5	2	3	4	5	20
2432	1251	474	111	70	52	40	28	0

.002	2432	4860
.0065	1251	8290
.01	474	3020
.01.5	111	1460
.02	70	910
.03	52	610
.04	40	460
.05	28	340
.20	0	2100

SPF 22050 100yr: 8900

Estimated Present (1975) and Projected Value of Development and Damages for Various Sized Floods

($1000's)

TABLE 5

		Present (1975)	Projected 1979	1989	1999	2009	2019	2029	2079
North Bank of Proposed Superstition Freeway									
Value of Development	SPF 55000 cfs	39161	52199	104729	265349	272219	272219	272219	272219
	100 10 cfs	4410	4563	5026	5435	5435	5435	5435	5435
	50 0 cfs	0	0	0	0	0	0	0	0
Damages	55000 cfs*	2969	4223	9016	20930	21546	21546	21546	21546
	10 cfs*	0	0	0	0	0	0	0	0
	0 cfs*	0	0	0	0	0	0	0	0
	*Location: Mesa Tempe Reach 3-1.								
Breakout in Tempe									
Value of Development	40000 cfs	196498	262326	283633	302452	302452	302452	302452	302452
	0 cfs	0	0	0	0	0	0	0	0
Damages	40000 cfs	8187	11538	12826	13964	13964	13964	13964	13964
	0 cfs	0	0	0	0	0	0	0	0
Gilbert									
Value of Development	40000 cfs	7891 ~~7651~~	8060 ~~7820~~	8572 ~~8332~~	114393 ~~8778~~	119118 ~~8778~~	119128 ~~119038~~ ~~8788~~	119128 ~~119038~~ ~~8788~~	119128 ~~119038~~ ~~8788~~
	620 cfs	5458	5578	5940	6262	6262	6262	6262	6262
	100 cfs*	1692	1735	1867	1984	1984	1984	1984	1984
Damages	40000 cfs*	1058	1097	1214	1329 ~~1318~~	1329 ~~1318~~	1329 ~~1318~~	1329 ~~1318~~	1329 ~~1318~~
	620 cfs*	346	357	393	423	423	423	423	423
	100 cfs*	71	73	80	87	87	87	87	87
	*Location: Gilbert Reach 1								

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Estimated Present (1975) and Projected Value of Development and Damages for Various Sized Floods ($1000's)

		Present	Projected						
		(1975)	1979	1989	1999	2009	2019	2029	2079
					Chandler East of SPRR				
Value of Development	460 Ac-Ft	21782	22172	23357	24447	24504	24504	24504	24504
	310 Ac-Ft	17168	17398	18098	18759	18817	18817	18817	18817
	235 Ac-Ft	13932	14119	14686	15227	15280	15280	15280	15280
Damages	460 Ac-Ft.	2975	3074	3374	3648	3660	3660	3660	3660
	310 Ac-Ft.	805	824	882	936	938	938	938	938
	235 Ac-Ft.	361	368	392	414	415	415	415	415
					Chandler West of SPRR				
Value of Development	5000 cfs	83774	85850	92160	97734	97734	97734	97734	97734
	0 cfs	0	0	0	0	0	0	0	0
Damages	5000 cfs	5028	5227	5830	6363	6363	6363	6363	6363
	0 cfs	0	0	0	0	0	0	0	0
					Gila Drain				
Value of Development	19000 cfs	8,676	8,676	408504	454,005	458,275	458,275	458,275	458,275
	25000 cfs	~~8325 4,064~~	~~8325 8,064~~	~~8325 8,064~~	~~8325 8,064~~	~~8325 8,064~~	~~8325 8,064~~	~~8325 8,064~~	~~8325 8,064~~
	0 cfs	0	0	0	0	0	0	0	0
Damages	19000 cfs	1,077	1,077	35,375	40,922	41,443	41,443	41,443	41,443
	25000 cfs	100	100	100	100	100	100	100	100
	0 cfs	0	0	0	0	0	0	0	0

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Estimated Present (1975) and Projected Value of Development and Damages for Various Sized Floods

($1000's)

		Present	Projected					
		(1975)	1979	1989	1999	2009	2019	2029	2079
Dobson Ranch Vicinity									
Value of Development	4300 cfs	111196	201066	239833	259337	259337	259337	259337	259337
	0 cfs	0	0	0	0	0	0	0	0
Damages	4300 cfs	5388	9725	11526	12404	12404	12404	12404	12404
	0 cfs	0	0	0	0	0	0	0	0
Ponding at Center Street and SPRR									
Value of Development	610 Ac-Ft	1434	1,446	1,472	20,290	21,131	21,131	21,131	21,131
	214 Ac-Ft	1097	1,105	1,130	1,152	1,152	1,152	1,152	1,152
	103 Ac-Ft	38	38	38	38	38	38	38	38
Damages	610 Ac-Ft	309	312	315	2,432	2,562	2,562	2,562	2,562
	214 Ac-Ft	89	89	92	93	93	93	93	93
	103 Ac-Ft	25	25	25	25	25	25	25	25

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Gila Floodway
X-sections of existing facility

	Width	depth
12+00	20'	6'
24+00	25	6
32+00	30	6
44+00	30	6
52+00	25	6
~~27+36~~	"	"
59+00	22	9
86+00	16	7
102+00	25	7
116+00	28	5
164+00	15	5
181+00	13	6
190+00	10	6
224+50	25	6

60□'

166' × 200' = 32,000'

$R = \frac{A}{WP}$

1170 to 1160 = 10' .00031

$R = \frac{60'}{22} = 2.73$

22'

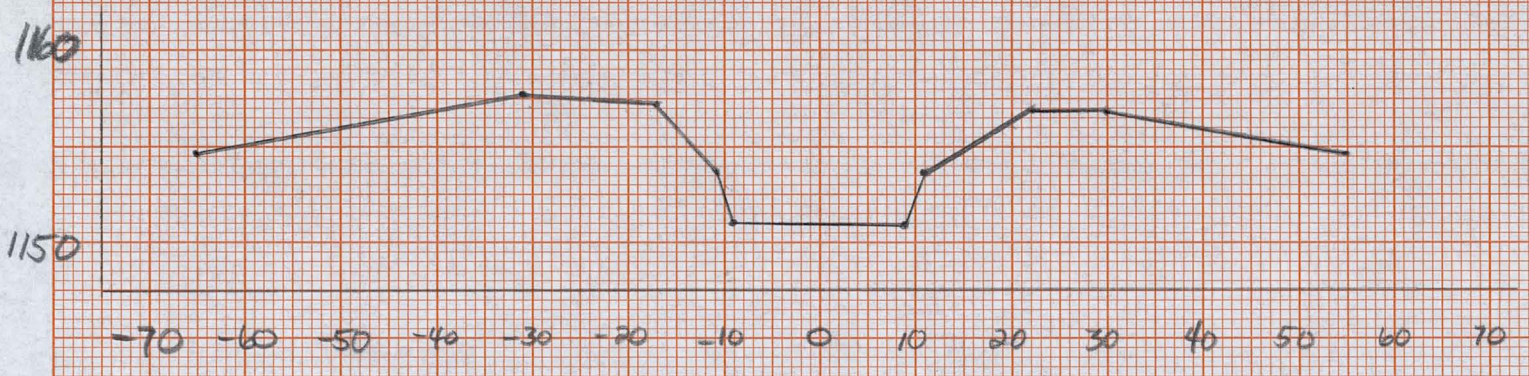
Y = 6.5, 60.

Q = 390

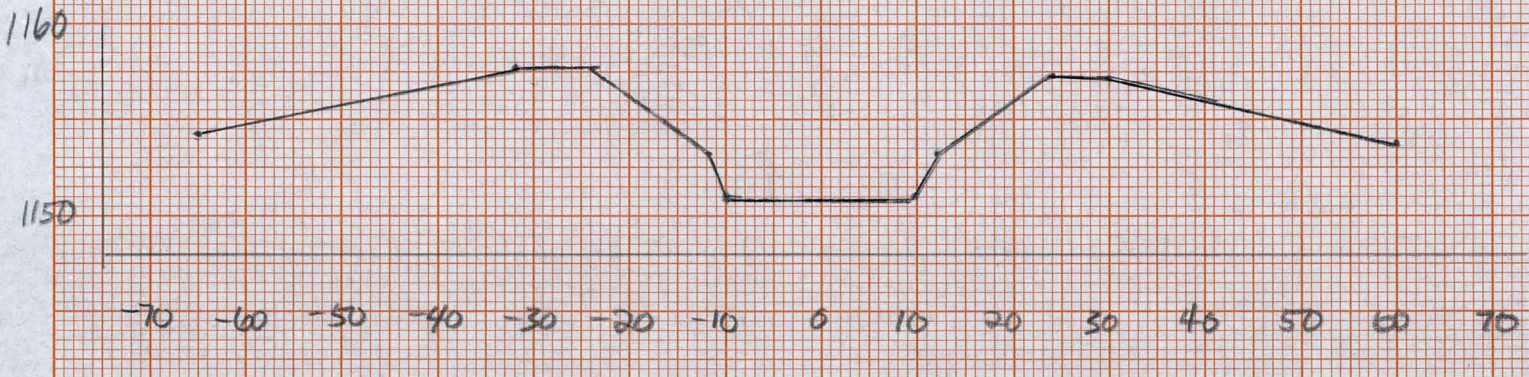
n = .025

V = 6½ ft/sec

K+E 10 X 10 TO ½ INCH 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 1323



Sec 218+00 Book W-278



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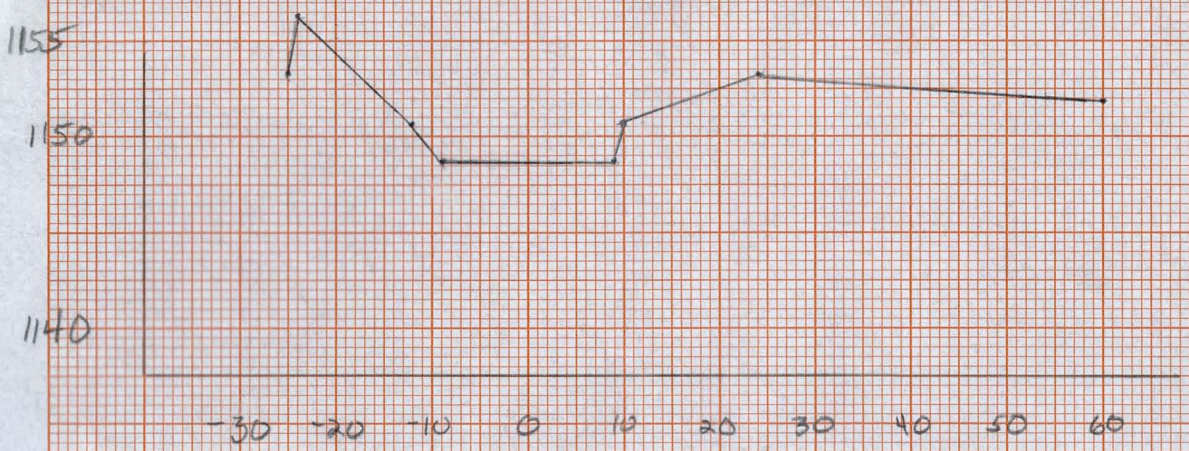
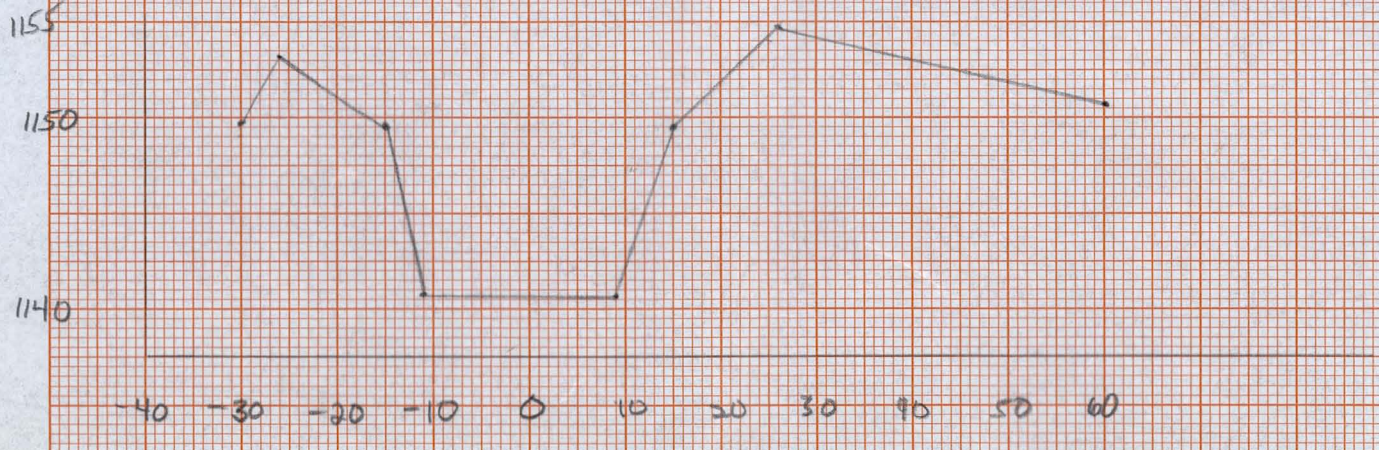
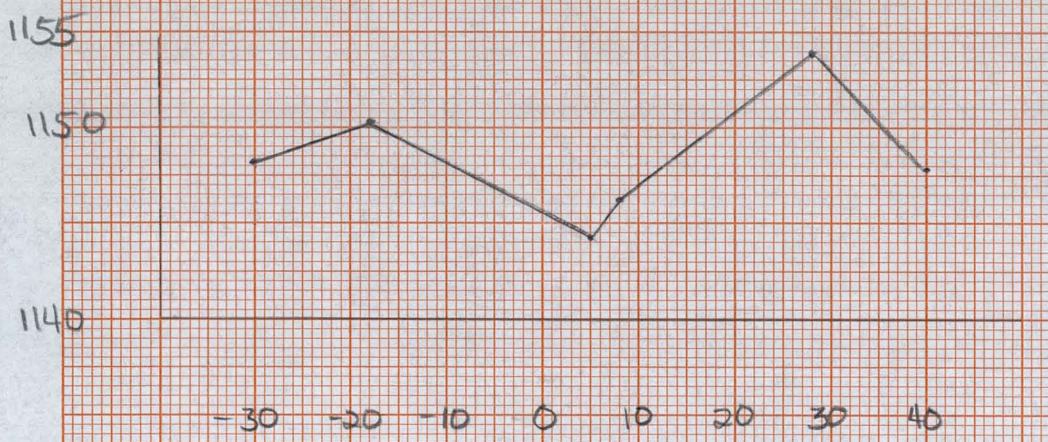


Sec 13+20 Book W-276

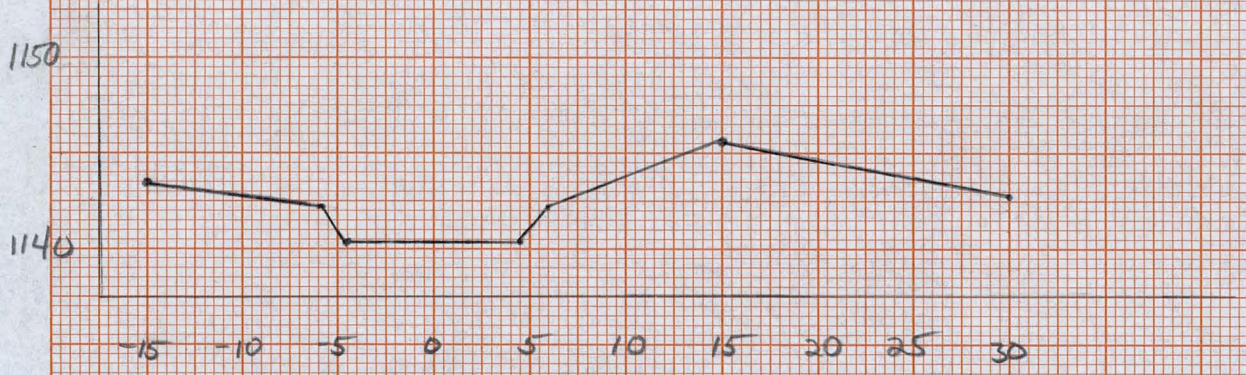


Sec 24+00 Book W-276

K&E 10 X 10 TO ½ INCH 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 1323



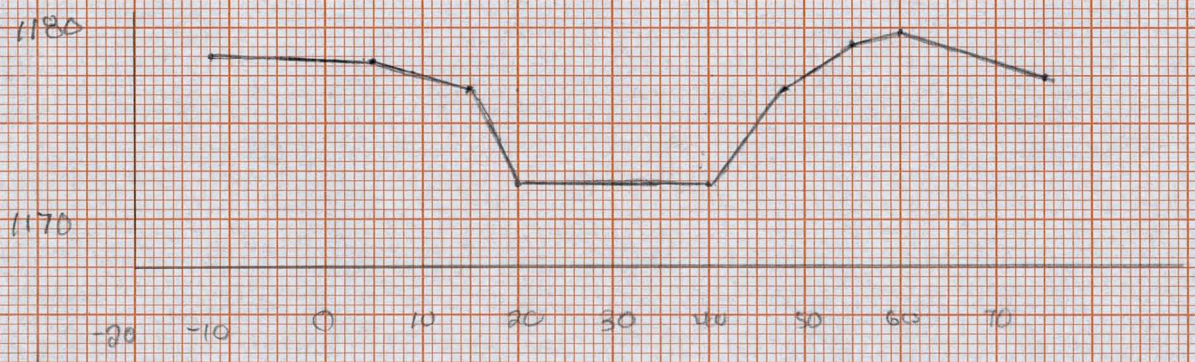
Sec 49+75 Book W-276



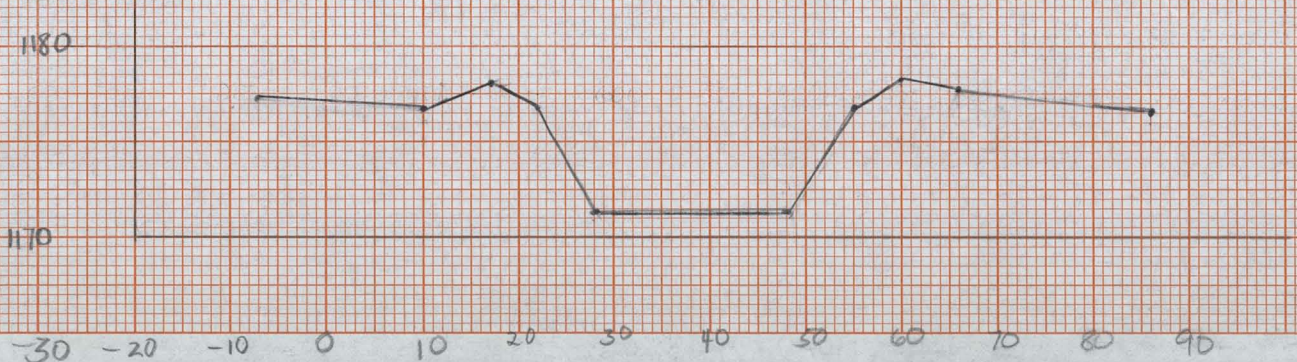
Sec 59+50 Book W-276

K+E KEUFFEL & ESSER CO. MADE IN U.S.A. 10 X 10 TO ½ INCH 7 X 10 INCHES

K&E 10 X 10 TO ½ INCH 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.



Sec 12+00 Book W-158



Sec 24+00 Book W-158

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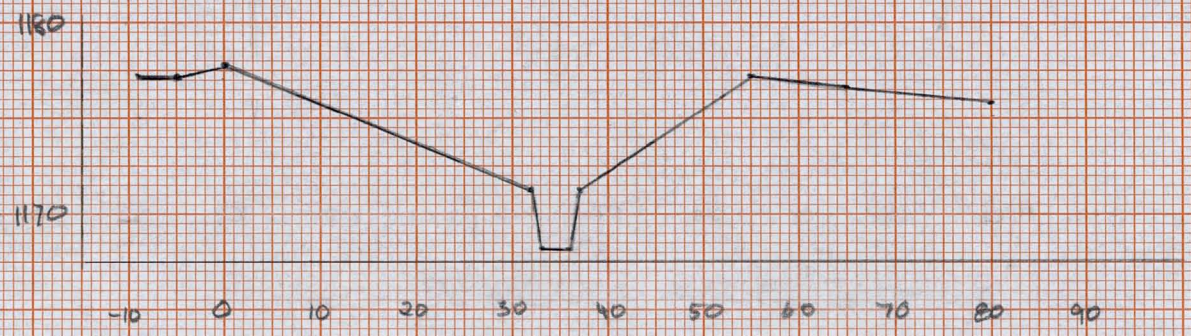
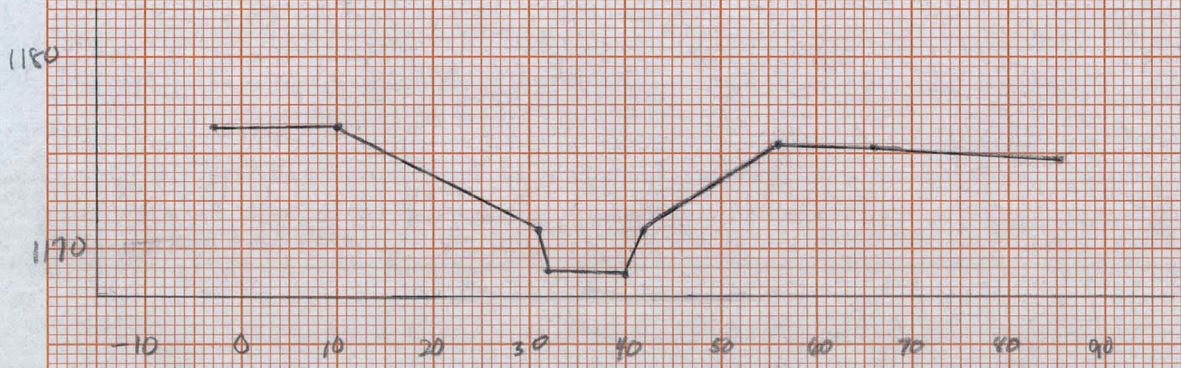


Sec 32+00 Book W-158



Sec 44+00 Book W-158

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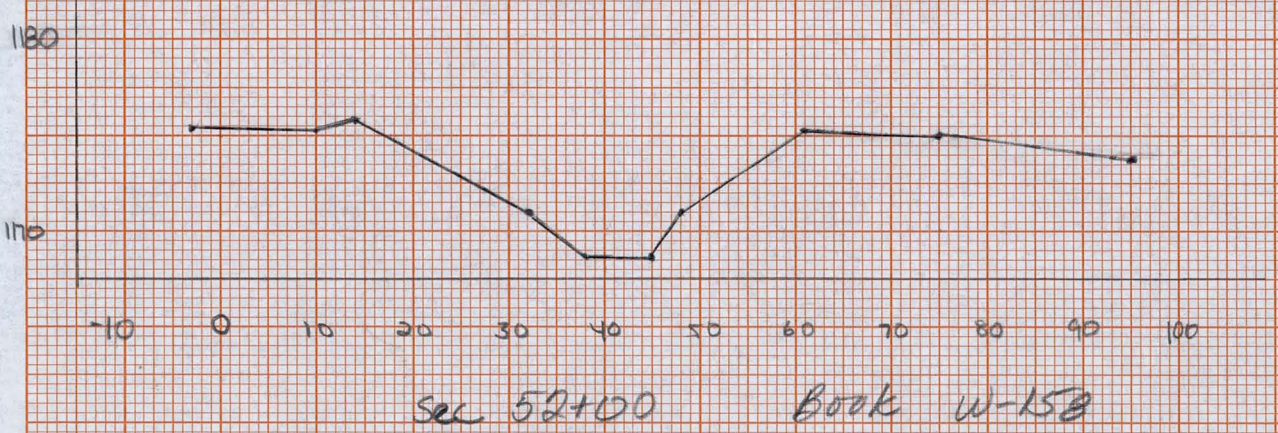
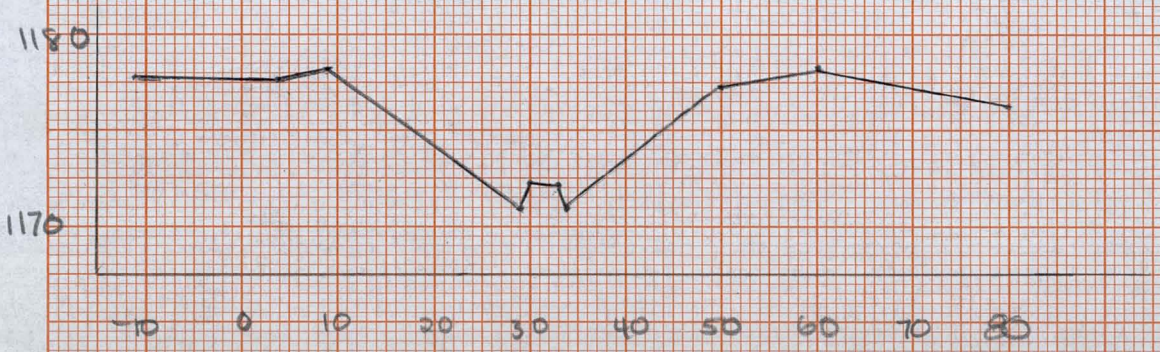


Sec 52+00 Book W-158



Sec 27+30 Book W-158

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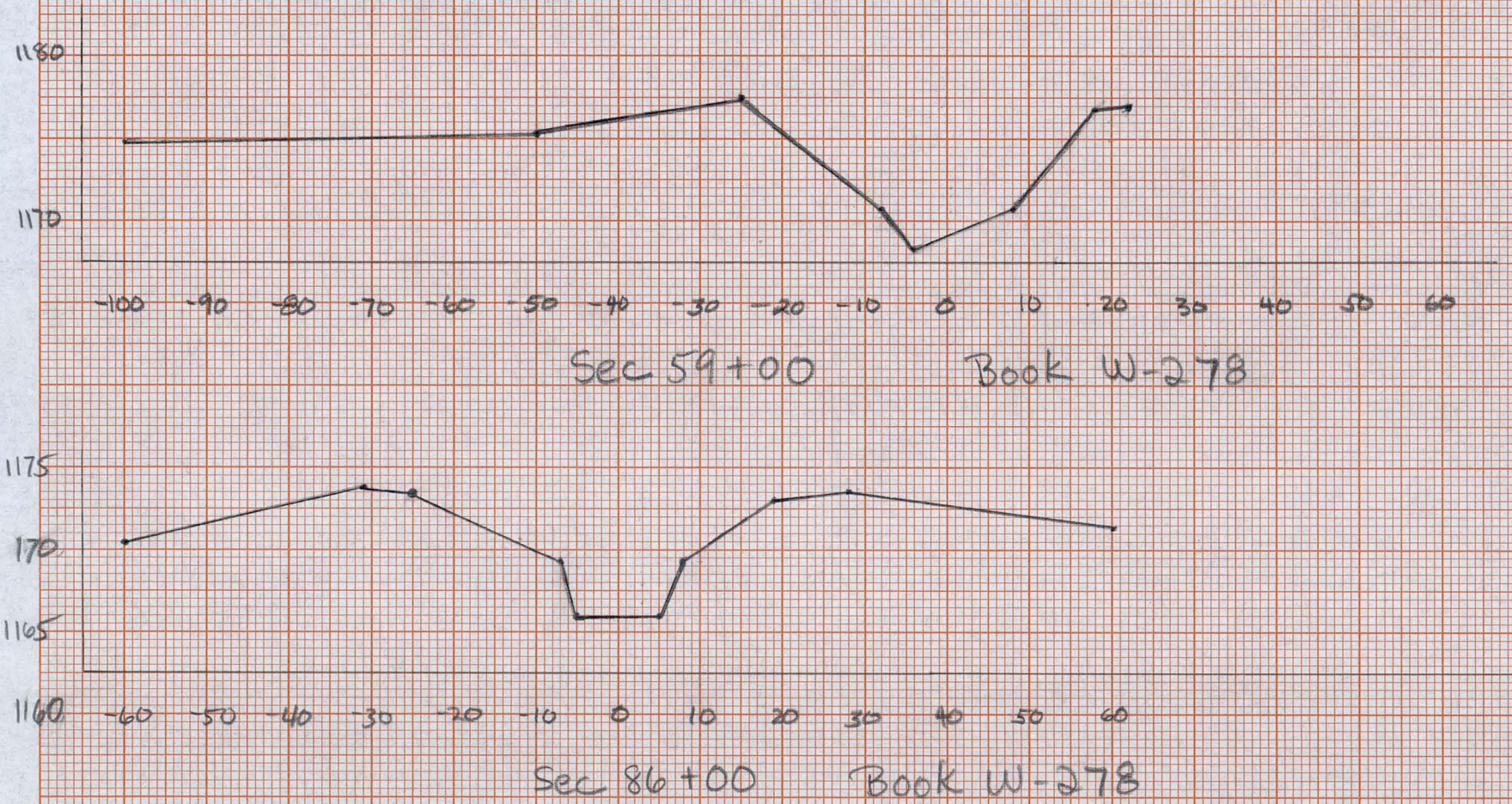

Sec 59+00 Book W-278

Sec 86+00 Book W-278

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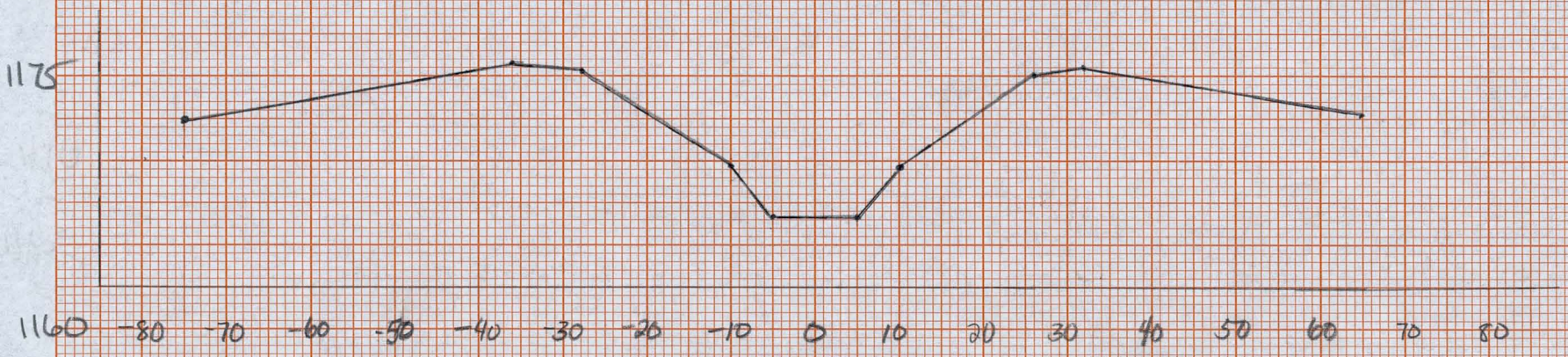
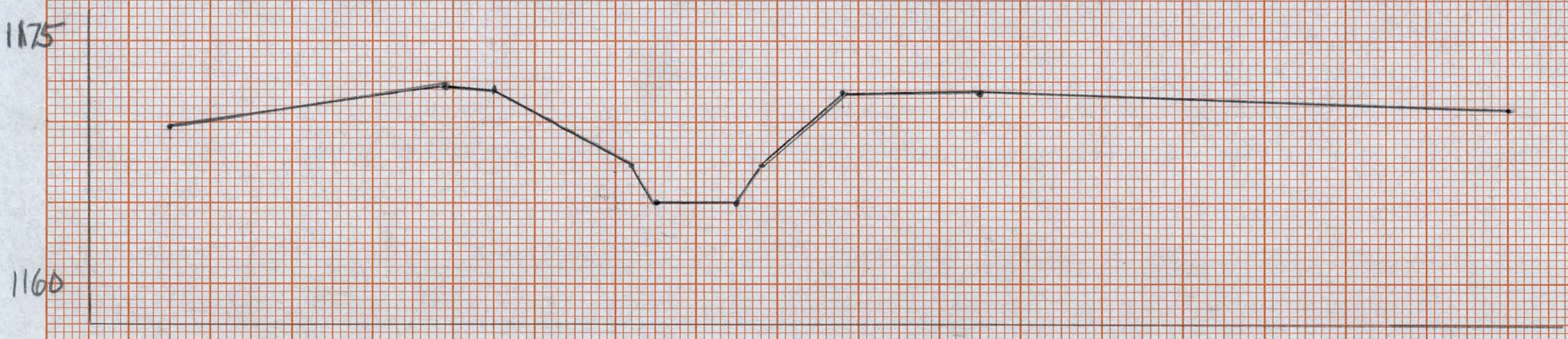
KEUFFEL & ESSER CO. MADE IN U.S.A.



Sec 72+00 Book W-278



Sec 102+00 Book W-278

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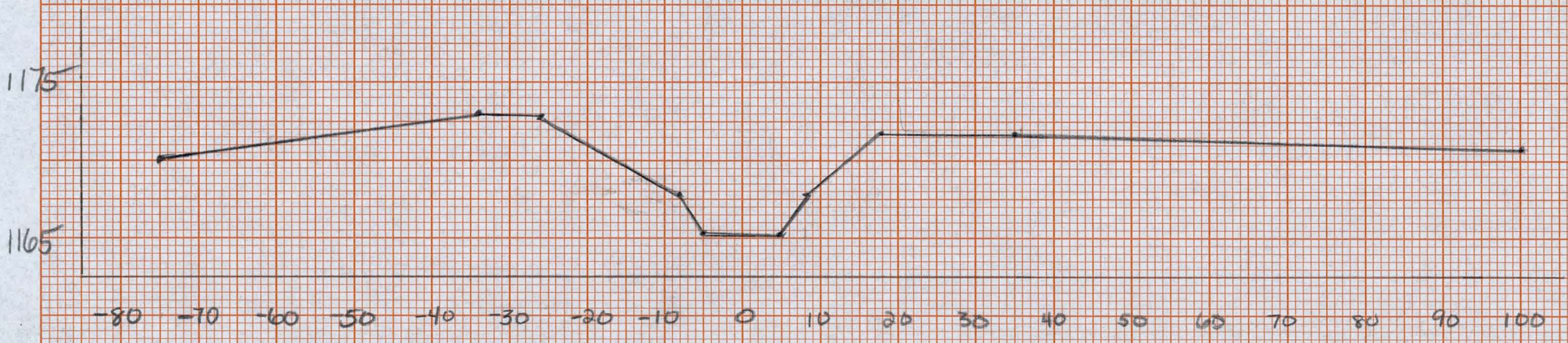
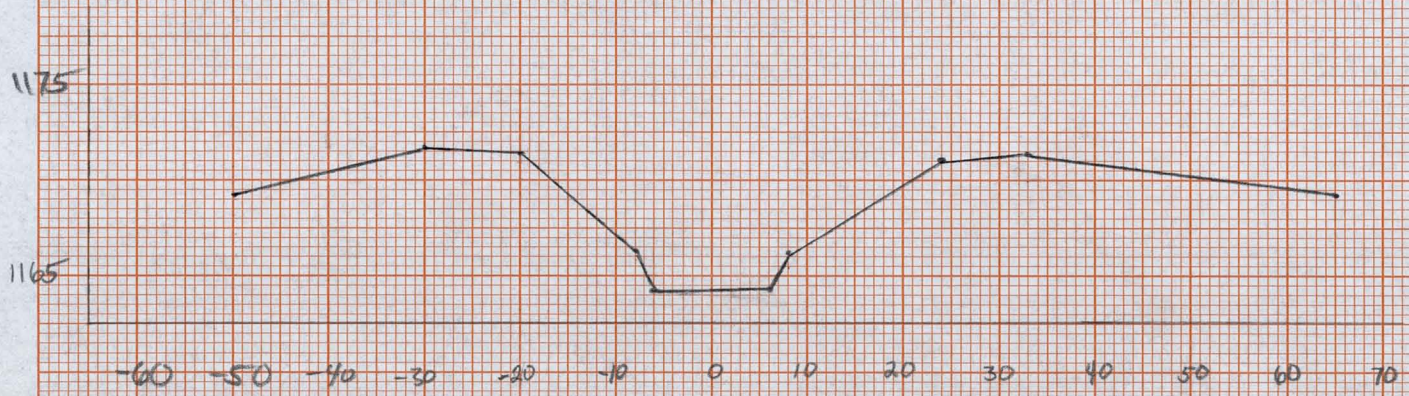
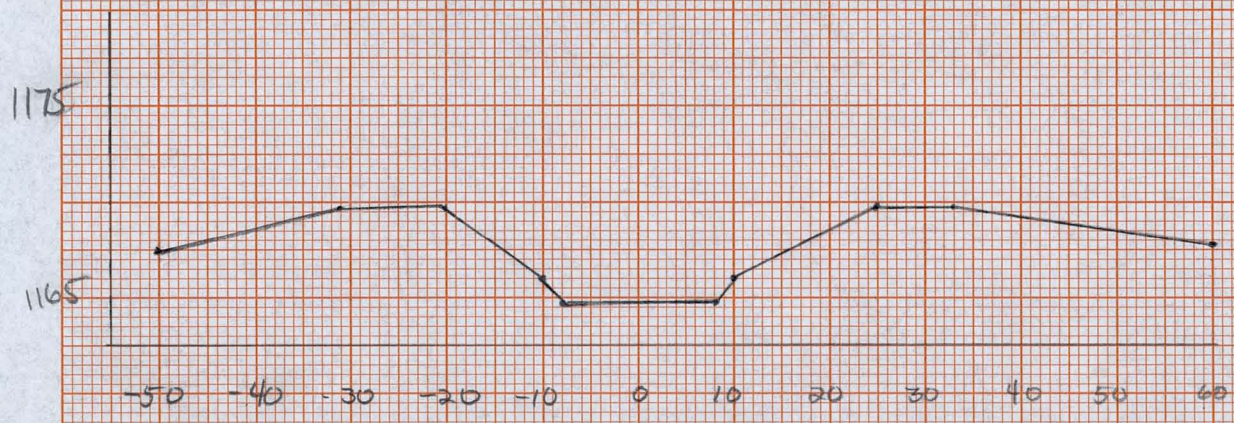


Sec 89+00 Book W-278



Sec 104+00 Book W-278

K+E 10 X 10 TO ½ INCH 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 1323



Sec 116+00 Book W-278

Sec 130+00 Book W-278

K+E 10 X 10 TO ½ INCH 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

Sec 143+00 Book W-278

Sec 164+00 Book W-278

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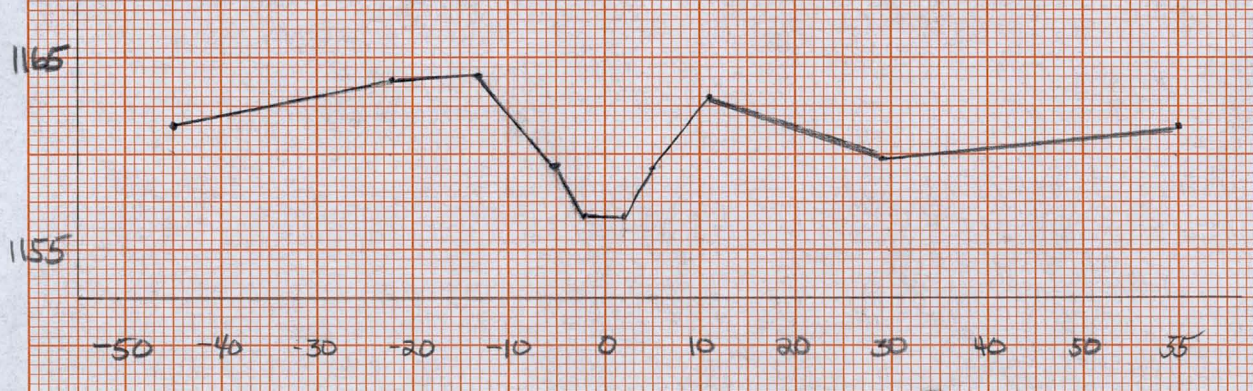
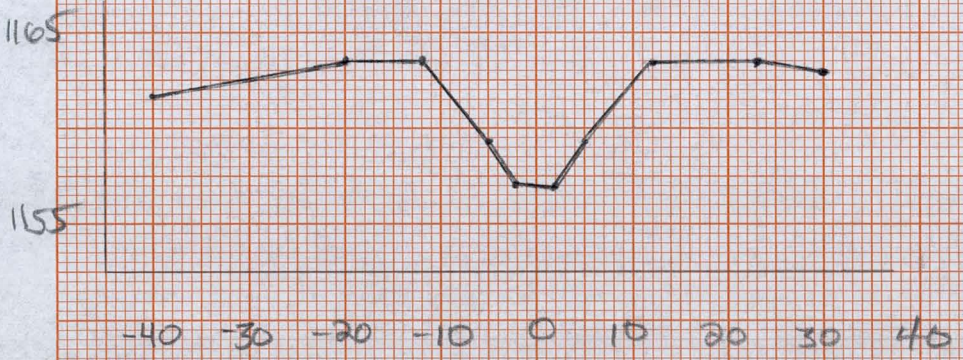
KEUFFEL & ESSER CO. MADE IN U.S.A.



Sec 168+00 Book W-278



Sec 166+00 Book W-278

Sec 181 + 00 Book W-278

Sec 190+00 Book W-278

K+E 10 X 10 TO ½ INCH 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 1323

K+E 10 X 10 TO ½ INCH 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

Sec 205+00 Book W-278

Sec 192+00 Book W-278

Gila Dr. - Notes

	Sta	invert
W-158	0 -	
	12	
	24 26-Road	
	27+30	
	32	
	44	
	52	
W-278	59	
	72	
	86	
	89	
	102	
	104	
	116	
	130	
	143	
	164	
	166	
	168	
	181	
	190	
	218	151
	224+60	150.8

	Sta	invert
W-276	13+20	148.7
	24	140.7
	44+75	144.2
	59+50	140.4

East Maricopa
Natural Resource Conservation District

110 North Oregon St. - Chandler, Arizona 85224

PHOENIX, AZ 852 85
PM
19 JAN
1976

Mr. Dan Young, Economist
U.S. Army Engineering District
Los Angeles
P.O. Box 2711
Los Angeles, Calif. 90053

GILA DRAIN FLOODWAY - Meeting Minutes
9:30 A.M. - January 13, 1976
Mesa Chamber of Commerce Building
(Called by East Maricopa
Natural Resource Conservation District)

Meeting called to order by Henry Haws, Chairman Maricopa County Board of Supervisors.

Lee Anderson, Army Corps of Engineers from Los Angeles explained the large scale map of Mesa, Tempe, Gilbert, Chandler and the location of Western Canal and the Gila Drain. It showed the areas subject to flooding.

Dean Sloan, City Engineer of Mesa, explained the plan developed with the State Highway Department to provid flood protection for the Superstition Freeway. This consists of a series of large storage pits designed to hold the run-off from a 50 year storm. It will be necessary to provide a system to empty these storage areas and to accomodate larger than 50 year storms. It appears that these plans or development of them will reduce the benefits of the Gila Drain project.

Grover Meranbets, Public Works Director for Tempe, explained the drainage system for the West end of the Superstition Freeway. He explained that Tempe also needs the Gila Drain to dispose of flood waters and especially for all of the area south of the Superstition Freeway.

Lynn Stuart, Town Manager of Gilbert, said that Gilbert has no place to go with flood waters except the Western Canal to the Gila Drain. Areas north of the railroad track are especially subject to flooding.

Charlie Johnson, City Engineer of Chandler, stated that Chandler has a problem of flooding along the highway down Arizona Avenue. They badly need the Pecos floodway to the Gila Drain.

Don Monack, representing the Salt River Project, explained the history and capacity of the Gila Drain. The project will make their 17 miles of right of way available. The project needs a way to dispose of excess water to prevent breaching the canals as they can not prevent picking up flood waters in some areas.

Herb Donald, Chief Engineer for the Maricopa County Flood Control District, stated that they have reviewed the hydrology of the Army Corps for the Gila Drain and agree with the Corps figures on hydrology. The County Flood Control District could build this project if they had the money. They have been unsuccessful in bond issue elections. Their tax mil levy is already committed for 10 years. The benefit-cost ratio was only .1 to 1. It is now up to about .6 to 1 but still far short of the 1 to 1 required for a Standard Flood Control project of the Corps.

Governor Alexander Lewis of the Gila River Indian Community was very generous in his promises of cooperation of the Gila River Indian Community. One plan to take the water south along the west side of the Maricopa Highway is presently prefered for the Gila Drain across reservation land.

Arnold Charles, member of the Gila River Indian Community Tribal Council and Chairman of the Resources Committee, said that the tribal members are effected by flood waters coming onto the reservation in many places.

Henry Haws, then stated that these flood problems affect all of the communities.

Representative John Rhodes summed up some of the problems presented and asked questions of the Corps of Engineers about the possibility of considering what has been done or will be done by the cities as local

(more)

contributions. He asked for other help that the Corps could provide if they can not develop the full project.

Major Terry Kirkpatrick of the Corps stated that they will research the situation for assistance that the Corps can provide.

Lee Anderson of the Corps explained some of the estimated costs of the project. One alternative would be to go North to the Salt River. This would cost 35 million. The estimated cost of the Gila Drain to the Gila River would be 27 million. A standard project is most advantageous for a benefit-cost ratio. Present legislation requires that 100 year flood plains be regulated. All future development in flood plains must be flood proofed for a 100 year storm. This requires floors 12" to 18" above curb height. The main problem from flooding is standing water and not flowing water. Standing water accumulates from local rains as well as off site when adequate drainage is not provided.

Ken Fooks, of the East Maricopa NRCD and Hohokam RC&D, summarized that the Flood Control structures built and to be built by the Soil Conservation Service East of Mesa, Gilbert and Chandler will prevent water from flowing into the cities and farming areas from the mountains. It is standing water created by roofs, asphalt, etc. that causes the standing water.

Bob Bogle, Secretary of the East Maricopa NRCD, asked questions about the size of a 100 year storm. ~~Ben Young~~, Corps of Engineers stated that a 100 year storm in Mesa would produce 1200 acre feet of water. It is considered to be 3.6" of water in 24 hours over the whole area. A 50 year storm is 3" of water in 24 hours. → Pete Peterson

Bob Yount of the Arizona State Land Department brought up insurance costs as a part of the benefits to be derived.

(more)

Representative John Rhodes summarized the meeting. Chairman Henry Haws closed with the assurance that the Maricopa County Flood Control District and the Board of Supervisors are intensly interested in the Gila Drain and solutions to these flood problems.

GILA FLOODWAY MEETING - January 13, 1976

NAME	ORGANIZATION
Leland Anderson	Project Manager - Corps of Engineers
Dan Young	Economist - Corps of Engineers
Grover Serenbetz	Public Works Director - City of Tempe
Dean Sloan	City Engineer - City of Mesa
Pete Peterson	Assist. City Engineer - City of Mesa
Terry Kirkpatrick	Corps of Engineers - Phoenix
Ruth Bajza	Corps of Engineers - Phoenix
Henry H. Haws	Maricopa County Supervisor
John Rhodes	U.S. House of Representatives
Alexander Lewis	Gila River Indian Community
Ken Fooks	East Maricopa NRCD & Hohokam RC&D
Jim Miller	East Maricopa NRCD - Chairman
Bob Bagle	East Maricopa NRCD - Secretary
Herb Donald	Flood Control District
Bill Jolly	Flood Control District
Dale E. Hodgell	Soil Conservation Service - Chandler
Robert Yount	State Land Department
Jack Moore	BIA - Sacaton
Arnold Charles	Gila River Indian Community
Don Womack	Salt River Project
A.E. McQueen	Salt River Project
Charlie Johnson	City Engineer - City of Chandler
Lynn R. Stuart	Town Manager - City of Gilbert
Omar E. Hood	Town Engineer - City of Gilbert
James R. Ferrin	Project Coordinator - Hohokam RC&D Project
Mark W. Dobson	East Maricopa NRCD - Supervisor

BOOK W-160

Continued from BK W-155 Pg 44

COMPLETE SURVEY OF OLD TEMPE DRAIN. FROM E¼ COR. SEC. 10 T1S R4E TO E¼ COR SEC 15 T1S R4E OR FROM 22E 1½S TO 22E 2½S.

BASELINE IS 14' E OF E SEC LINE OF SEC 10 T1S R4E & SEC 15.

A
15

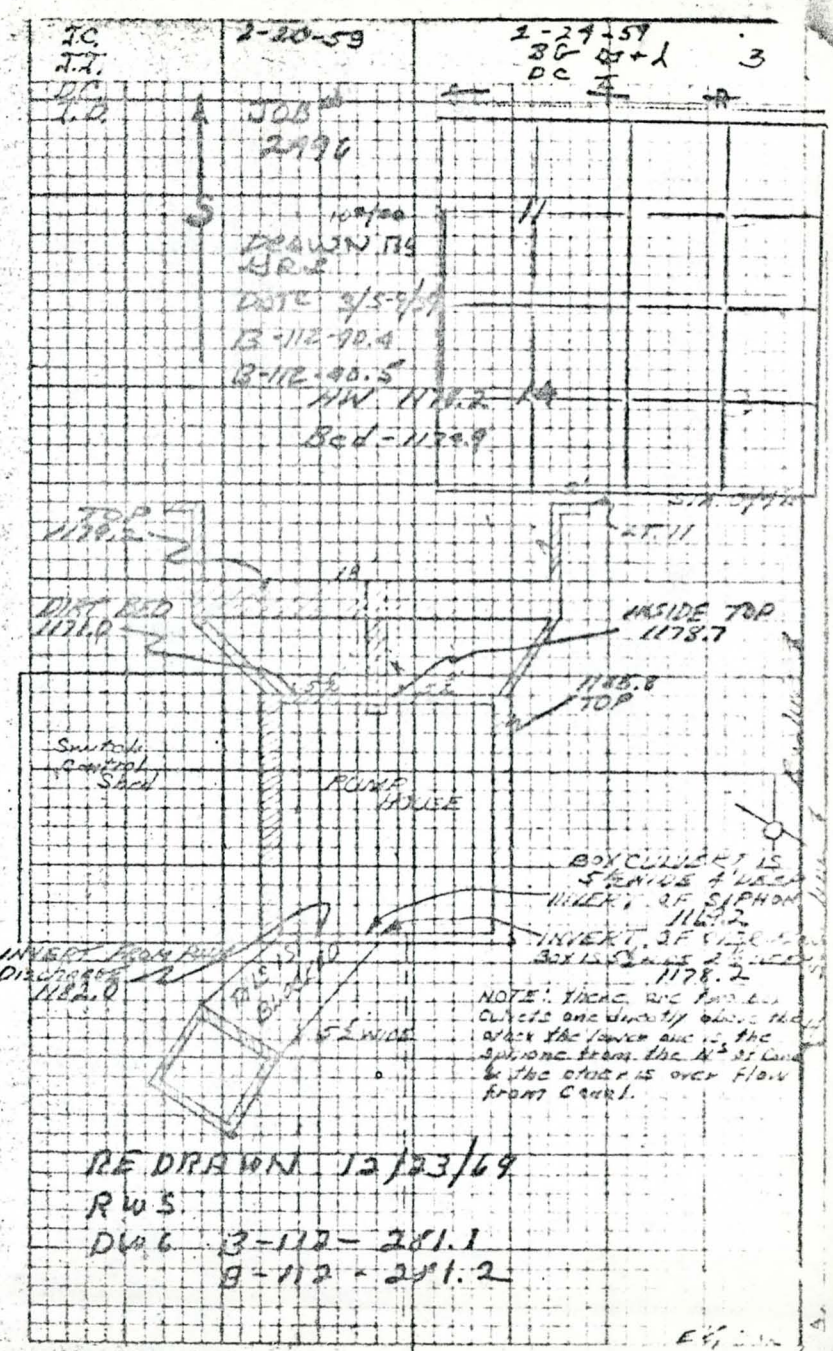
1188.29 TBM "+" NE Conc Bridge Rail E. Rd

0+25 FW'R POLE Lt 1

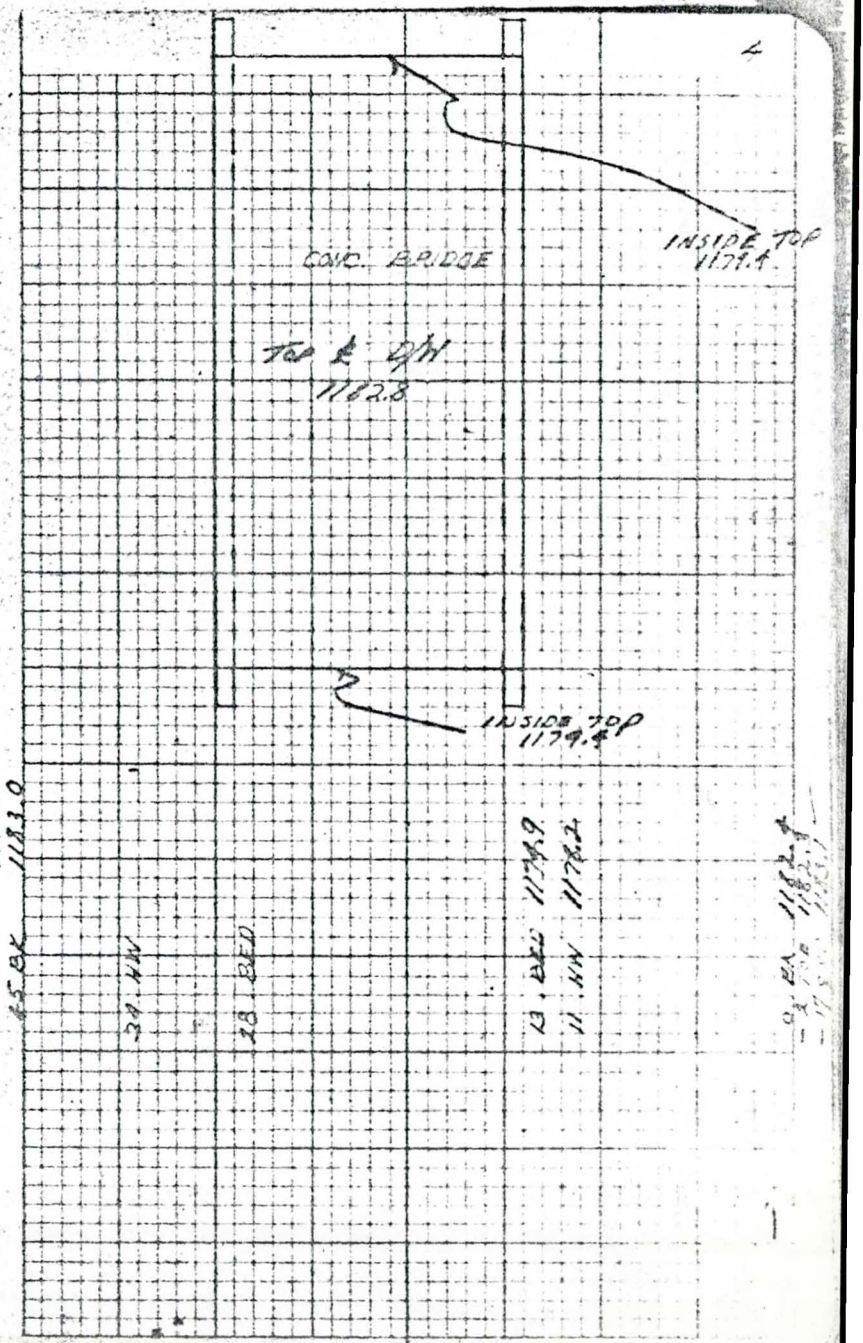
0+19 NW Cor. PUMP HOUSE Lt 45

0+13 NW Cor DISCHARGE BOX Lt 29½

0+00 IS E¼ COR. SEC. 10 T1S R4E RIM



2+14	END OF BRIDGE			LT 18	
2+00	1181.4	N.GR.			
1+82	N^{E} OF CONC BRIDGE			LT 18	
0+65	X-SEC				
0+45	DOWN. SUY			LT 1	



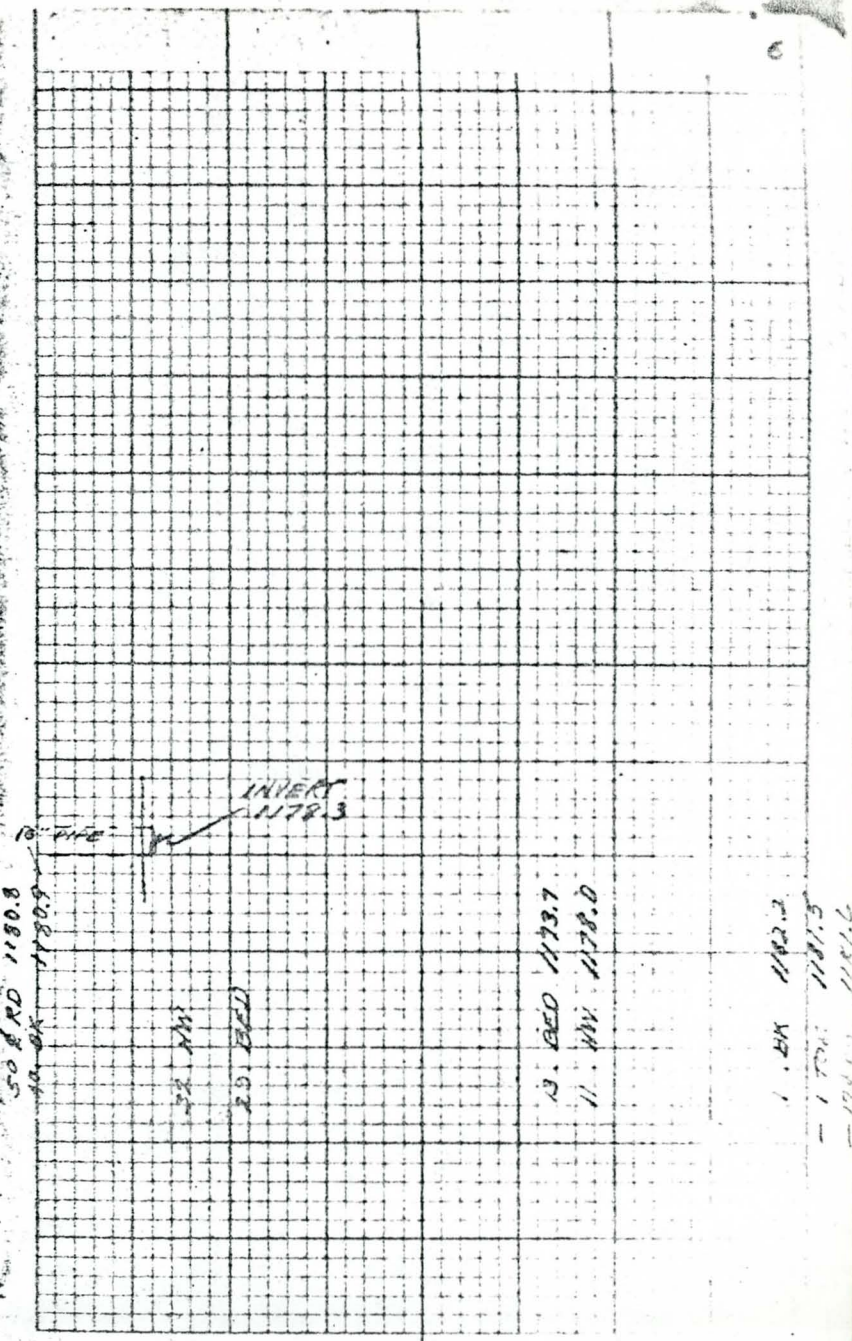
10+00	1180.5	AV GR			
TBM 9+57	1181.75	NAIL IN	PWR POLE W^{S}RD		
9+00	1180.8	AV GR			
8+00	1180.6	AV GR			
7+00	1180.6	AV GR			
6+00	X-SEC.				
5+00	1180.7	AV GR			
4+00	1180.9	AV GR			
TBM 3+39	1182.30	NAIL IN	PWR POLE W^{S}RD		
3+00	1181.1	AV GR			
2+15	TEL. POLE			LT	1

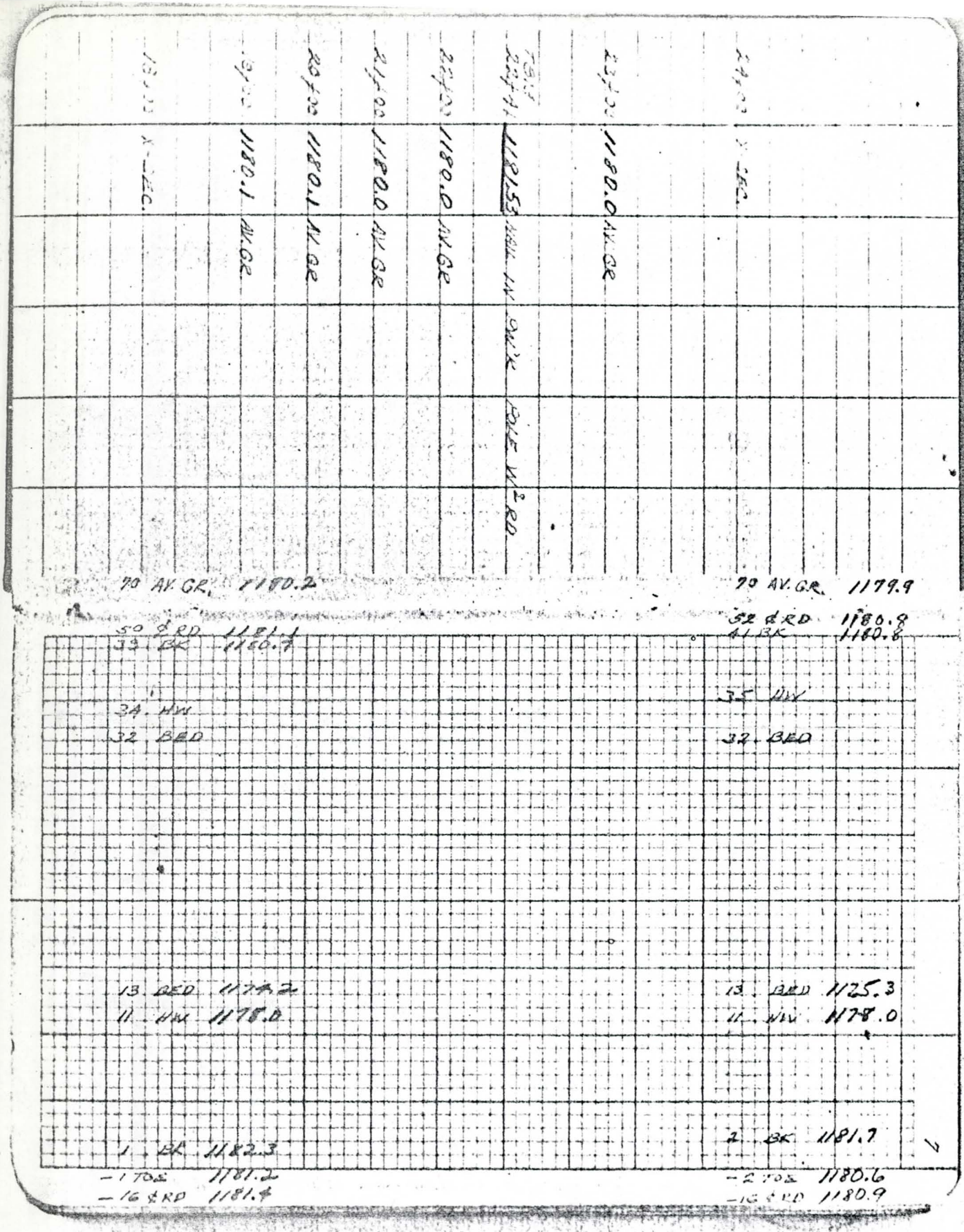
10 AV GR 1180.7
30 AV GR 1181.4
38 BK 1181.8
32 HW
32 BED
13 BED 1179.0
11 BK 1178.0
1 BK 1182.5
1181.4
1182.0

5

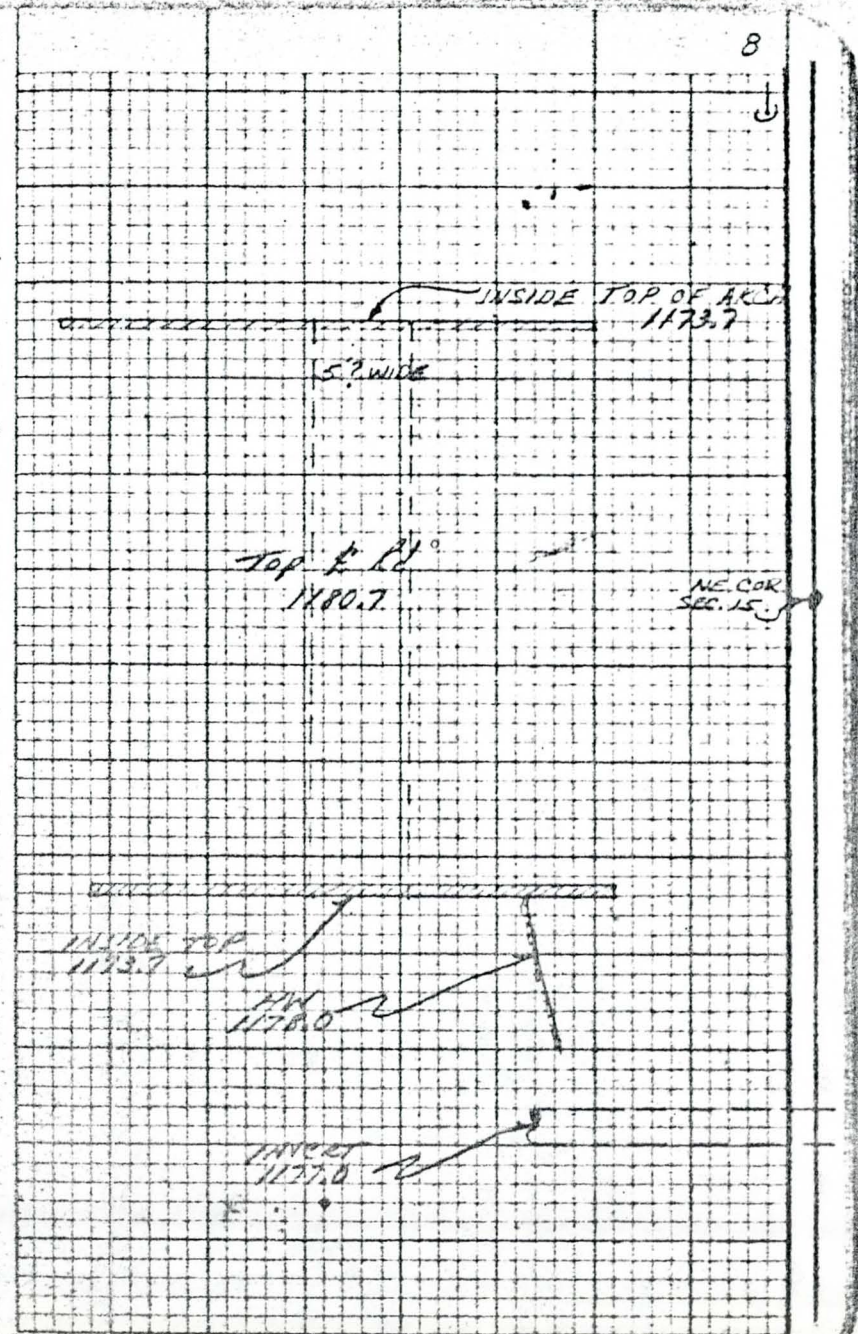
3

17+00	1180.2	AV. GR			
16+00	1180.3	AV. GR.			
TBM 15+24	1181.42	NAIL IN PWR POLE W/ RD			
15+00	1180.4	AV GR			
14+00	1180.6	AV. GR			
13+00	1180.6	AV. GR			
		OF PIPE			
	(1179.6)	LOW GR SW COR. FIELD 40'E			
12+24	16" CONC. DRAIN PIPE			LT 34	
12+00	X-SEC.				
11+00	1180.4	AV. GR			




70 AV. GR. 1180.2
50 & RD 1181.1
39 BK 1180.7
34. HW
32. BED
13. BED 1174.2
11. HW 1178.0
1 BK 1182.3
-1 TOE 1181.2
-16 & RD 1181.4
70 AV. GR. 1179.9
52 & RD 1180.8
41 BK 1180.6
35 HW
32. BED
13. BED 1175.3
11. HW 1178.0
2 BK 1181.7
-2 TOE 1180.6
-16 & RD 1180.9

	DRAIN SUY			LT 1	
26/91	S^E OF	CONC	CULVERT	LT 10'	
26/93	NE. COR. SEC. 15			RT 14	
TBM 26/15	1182.20	NAIL IN PWR POLE NW COR INTER.			
26/11	N^E CONC.	CULVERT N^E 1ES AT 22E			
26/00	1179.6	AV. GR			
	1179.5	LOW GR	S.E COR FIELD (WILCOX UNIT)		
25/88	24" CONC.	DRAIN PIPE	FROM W^E RD.	LT 15	
25/00	1179.8	AV. GR.			



[illegible]	1179.2	AV. GR.			
30+00	1179.3	AV GR			
32+[illegible]	1179.4	AV GR			
31+00	1179.5	AV. GR			
31+[illegible]	1181.85	WALL IN	TEL POLE E 3RD LT		
30+00	X-SEC.				
29+00	1179.7	AV. GR			
28+00	1179.8	AV. GR			
27+01	TEL. POLE			LT ½	
27+00	1179.8	AV. GR			

1179.7 TO AVGR
1179.2 SA 3RD

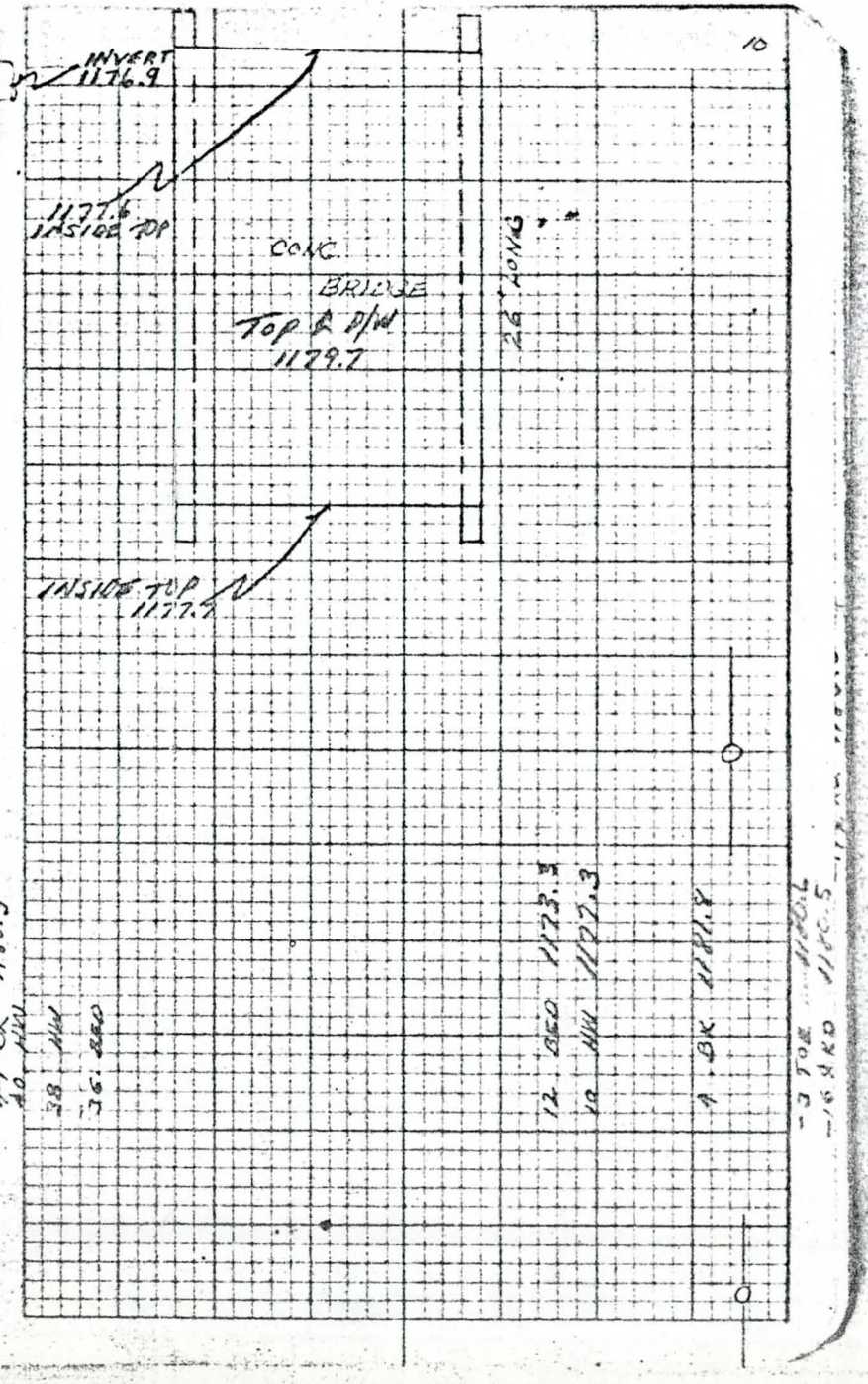
43 BC 1179.6
38 HW
36 BED

13 BED 1175.0
11 HW 1177.8

1 BC 1180.8

- 3 TRS 1180.3
- TRS 1180.6

33+12	2" CONC BRIDGE			LT 16	37' PIPE
33+11	24" C.M.C. PIPE (W/ RIP DITCH)			LT 48	
33+46	W/E CONC BRIDGE apx			LT 16	
39+00	1179.0	AV. GR			
TBM 33+24	1182.23	NAIL IN TEL. POLE E 5 RD		LT 2½	
33+00	1179.1	AV. GR			
37+00	1179.1	AV. GR			
36+00	1 SEC.				
35+00	1179.1	AV. GR			
34+52	TEL. POLE			LT 2	



[illegible]	1178.8	AV. GR.			
TBM 42+[illegible]	1182.26	NAIL IN TEL POLE E 3 RD LTS			
42+[illegible]	1178.9	AV. GR.			
41+[illegible]	1178.8	AV. GR.			
42+[illegible]	1178.9	AV. GR.			
42+[illegible]	X-SEC.				
TBM 41+26	1182.06	NAIL IN TEL POLE E 3 RD LT 3½			
41+[illegible]	1179.0	AV. GR.			
40+[illegible]	1179.1	AV. GR.			
33+34	TEL POLE		LT 3		

1178.9 AV GR

56 4 RD 1179.5
44 BK 1179.7
33 AW
36 RED

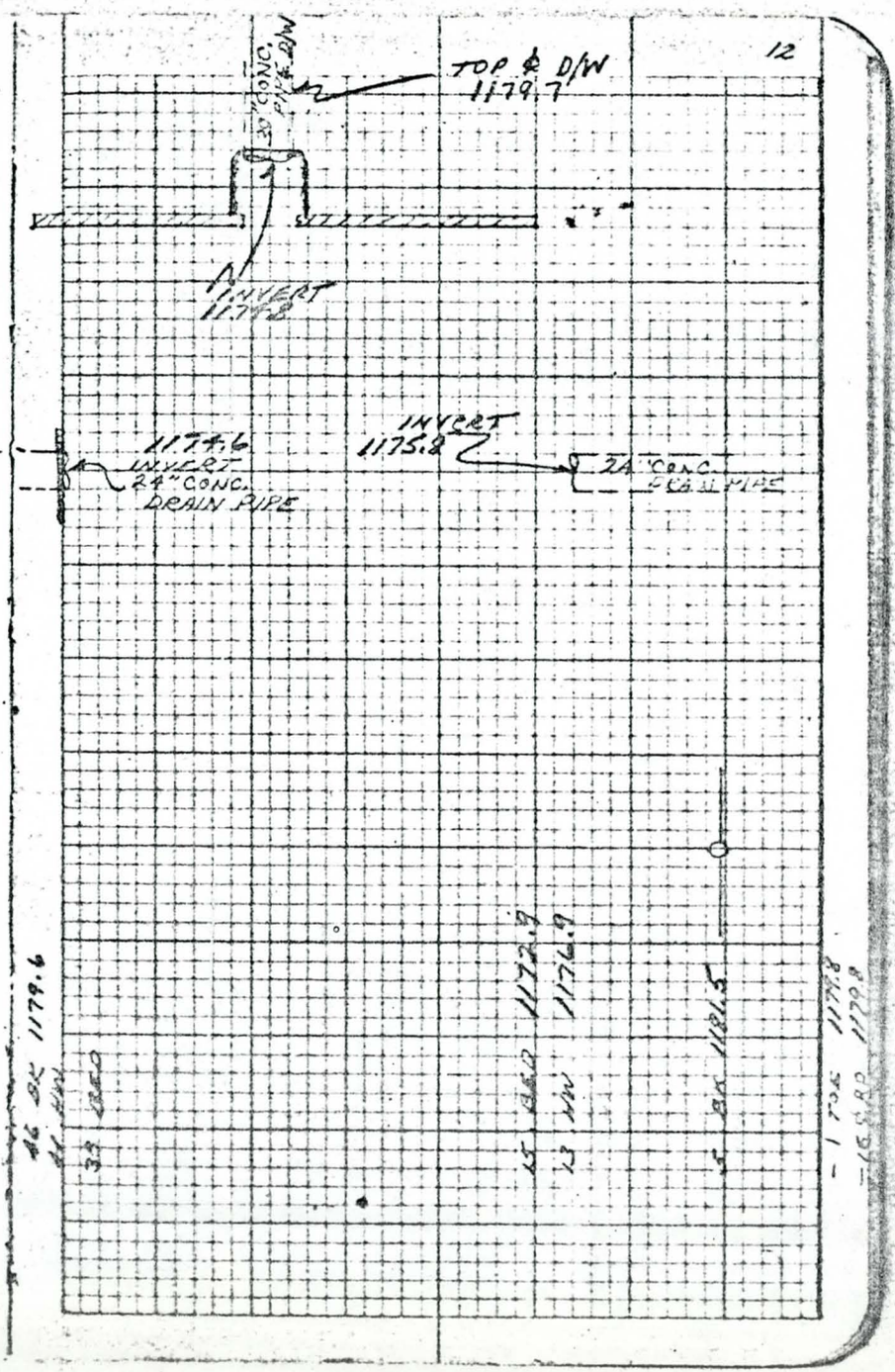
13 RED 1173.2
13 AW 1177.2

3 BK 1181.6

3 TEL 1180.8
17½ RD 1180.0

11

52		N.E. HOUSE W^{S} D/W		AT 15-42	
	1177.8	LOW GR SW. COR FIELD E^{S} RD.			
	1177.6	LOW GR SE COR FIELD W^{S} RD.			
52	24"	CONC. DRAIN PIPE'S		AT 13 - 40	
52	1178.2	AV. GR			
51	1178.4	AV. GR			
50	1178.4	AV. GR			
TBM 49	1182.18	NAIL IN TEL. POLE	AT 5		
49	1178.5	AV. GR			
48	X-SEC				
47	1177.3	AV. GR			



W¼ COR SEC 11 T1S R4E

NW To SW COR CNL BRIDGE 54.4'
NE To SE COR CNL BRIDGE 55.0'
W To PP 23.8'

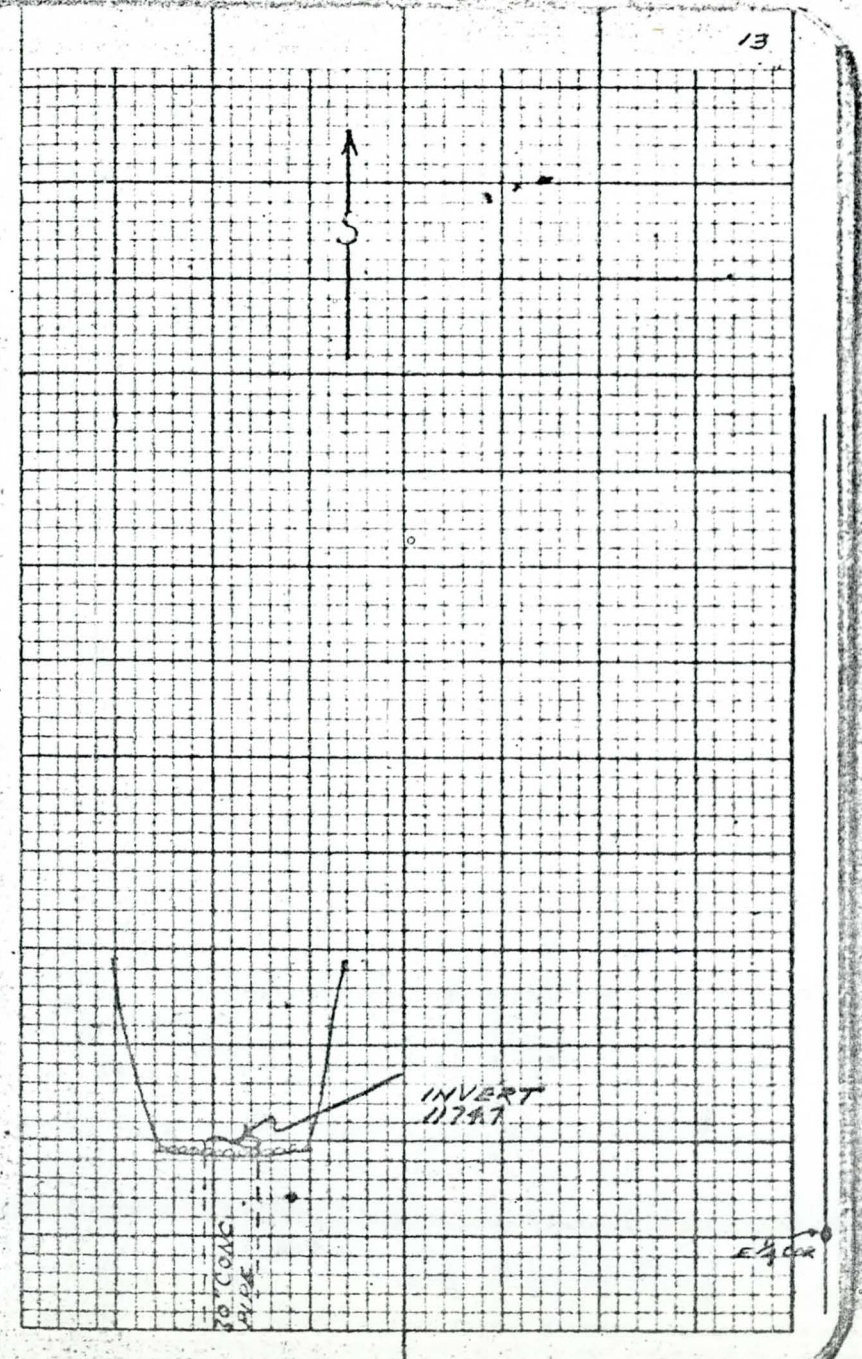
SW COR SEC 11 T1S R4E BC IN HH.

W To PP 48.3'
NE To PP 67.2'
SE To REBAR & HDWL 51.1'
SW To N/T IN ROUND COR POST 60.9'

53+10 1180.12 TBH Nail Pine Tree S.P.W.Rd

52+33 SE 30" CONC. PIPE D/W 47.29

52+33 E¼ COR. SEC. 15 T1S R4E RT 14



BOOK W-15P

Complete Survey of Old Tempe Drain
from E¼ Cor. Sec 15 T1S R4E to
E¼ Cor Sec 22 T1S R4E

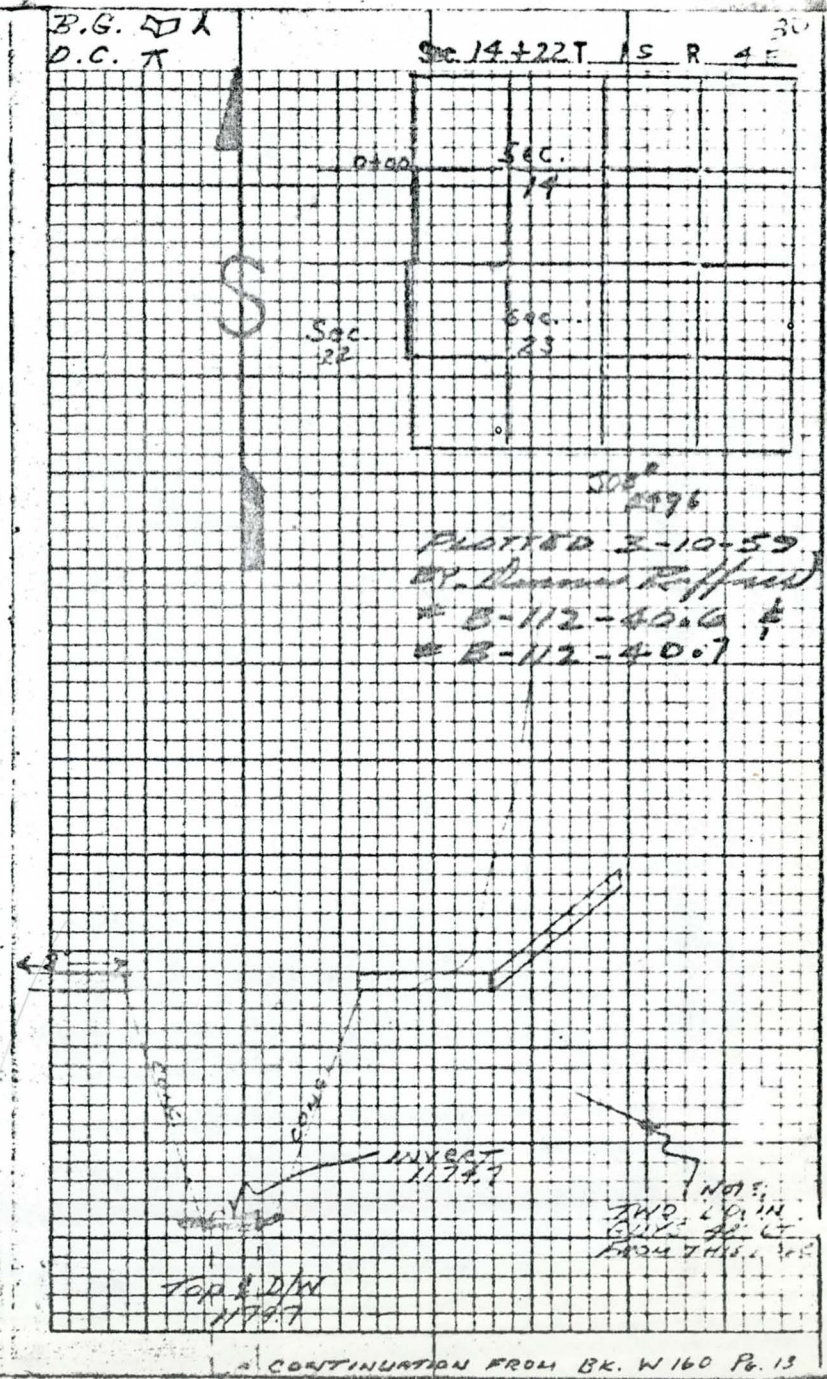
TBM 1183.29 "+" NE Conc Bridge Rail
E Bridge on Western Canal 22E 1½3

Baseline is a 14' O.S. to E of Sec.
line from E¼ Cor Sec. 15 T1S R4E
to N.E. Cor Sec. 22 T1S R4E

Baseline is a 12' O.S. to W of Sec.
line from N.E. Cor. Sec. 22 T1S R4E
to E¼ Cor. Sec 22 T1S R4E

This survey is a continuation
from Bk. W-160 Pg. 13

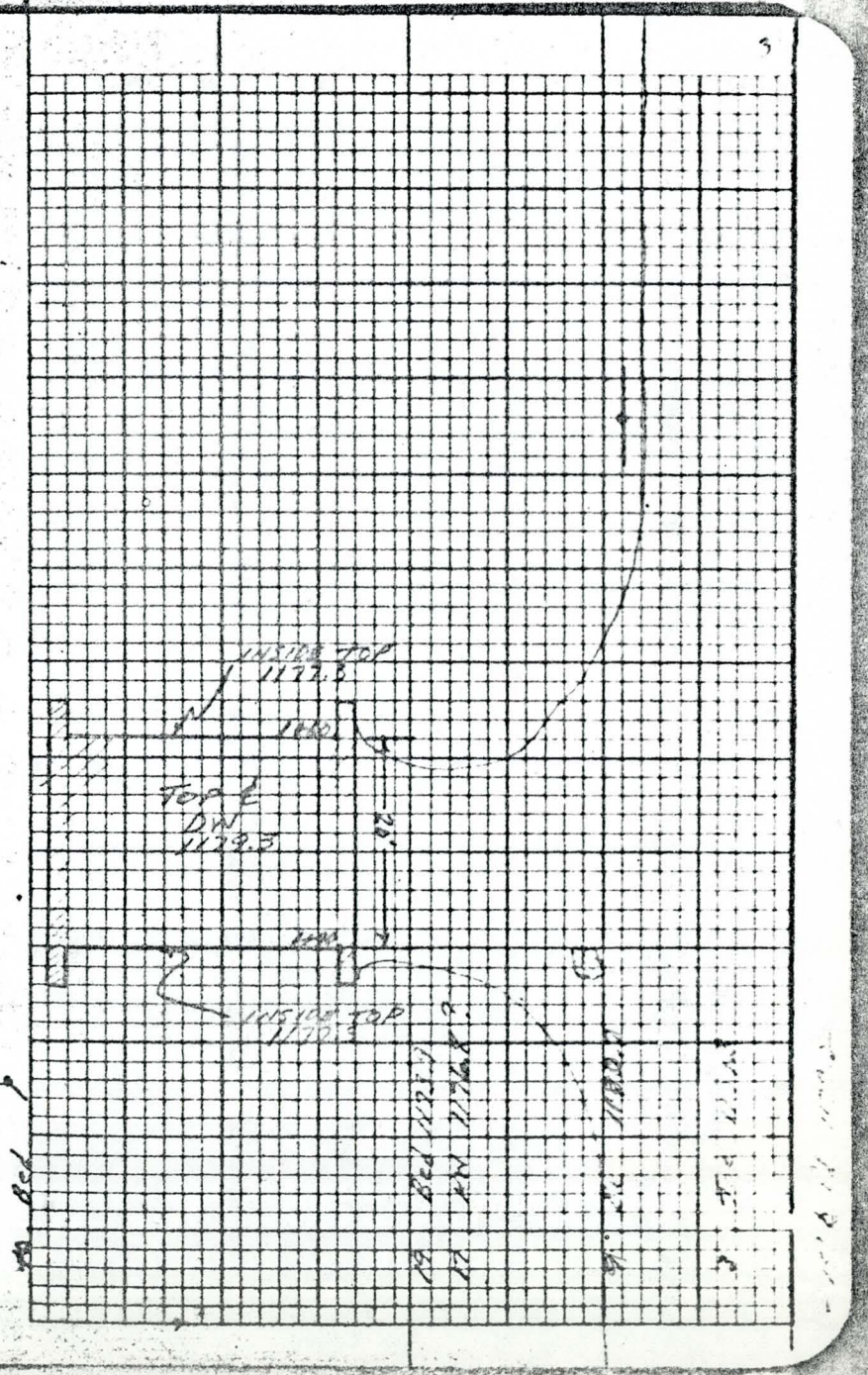
0+22	1180.12 TBM Nail Pwr Pole W Rd	
0+19	Tel + Pwr Serv Pole	Lt 9'
0+09	SE 30" C.P. D/W	Lt 30½'
0+00	E¼ Cor. Sec. 15 T1S R4E	Rt 14'



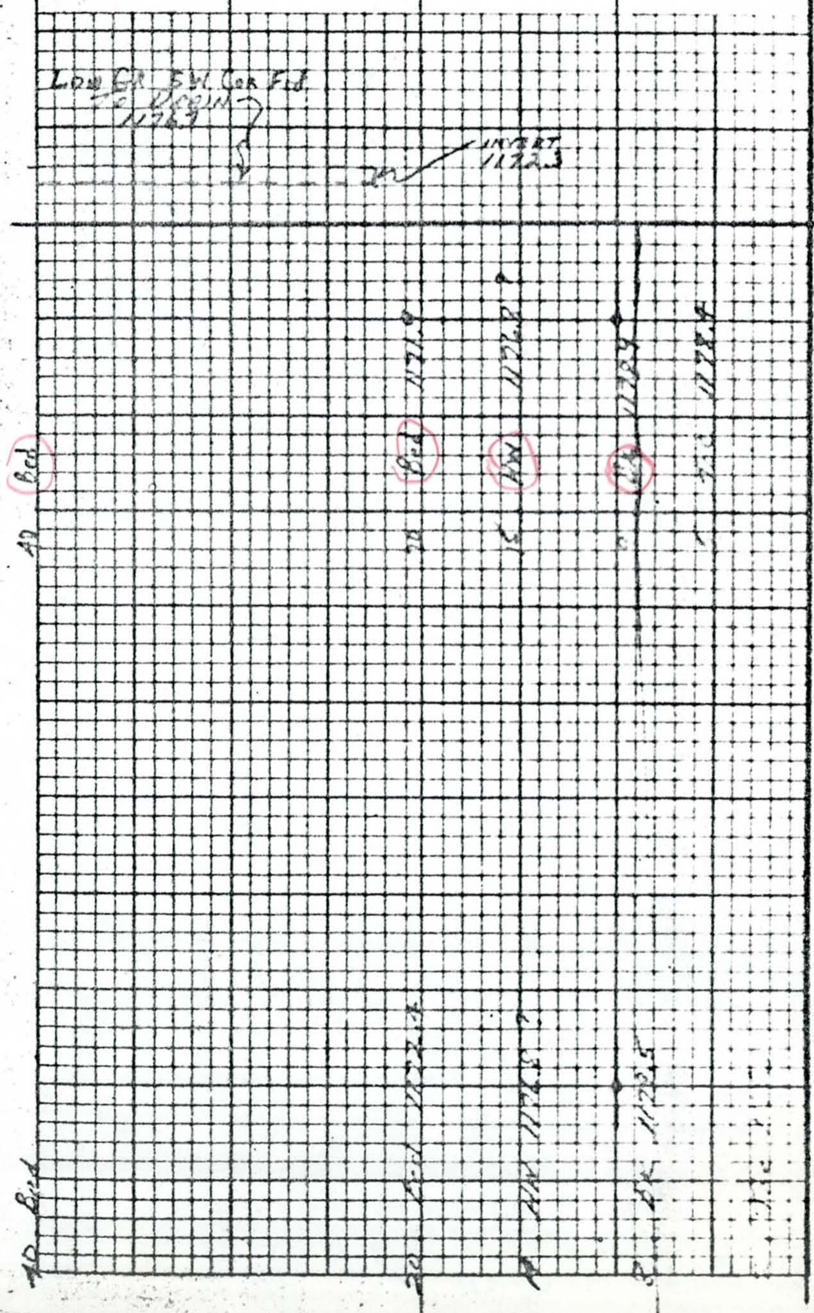
NOTE: TWO LOCATIONS OBTAINED FROM THIS POINT

CONTINUATION FROM BK. W 160 Pg. 13

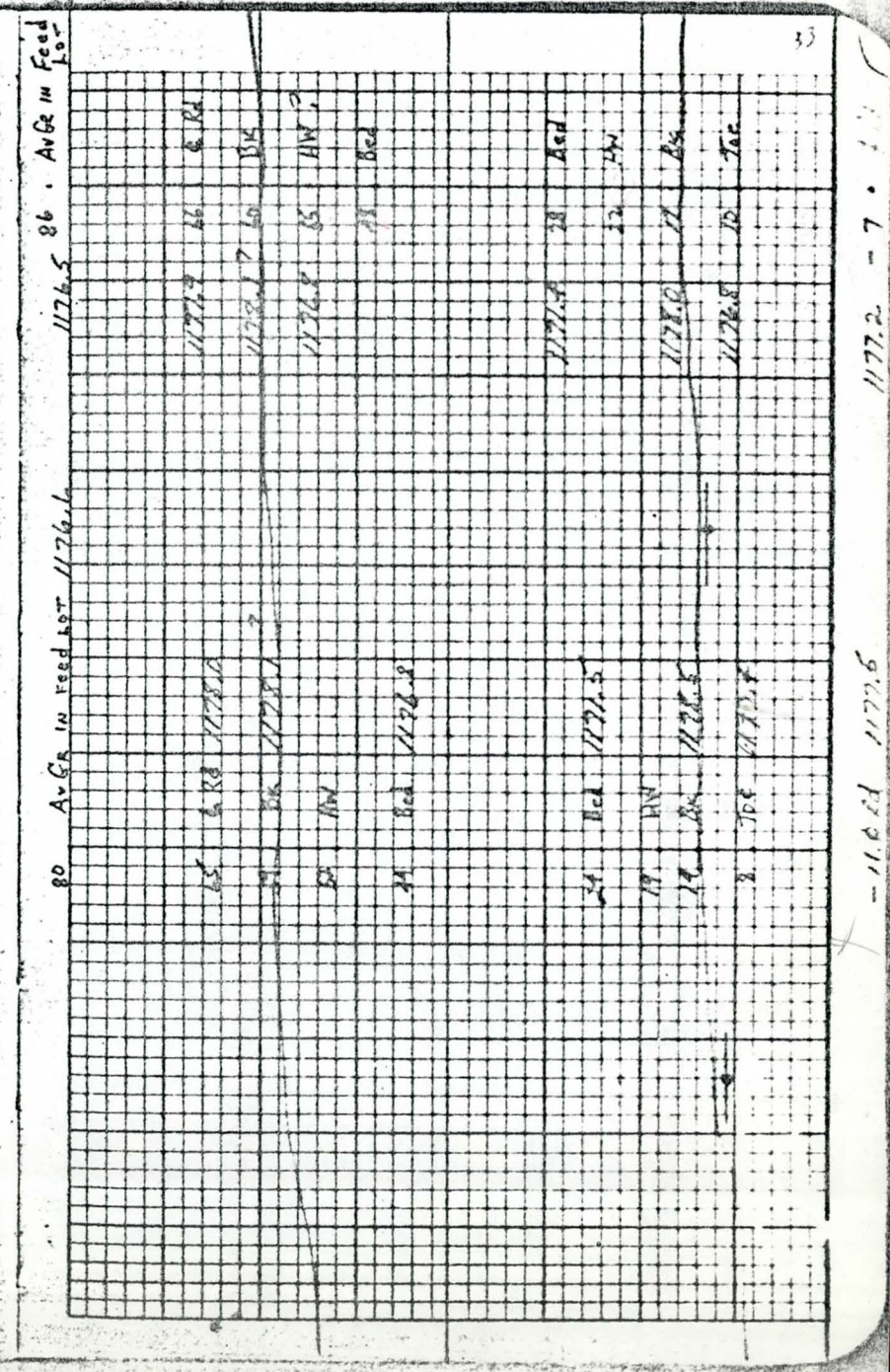
5+00	1178.1	Av Gr			
4+00	1178.4	Av Gr			
3+40	1180.74	TBM	Nail Tel Pole		E Rd
3+40	Tel Pole				Lt 9'
3+00	1178.5	Av Gr			
2+00	1178.1	Av Gr			
1+60	End	Bridge			Lt 23'
1+40	Start	Conc	D/W Bridge		Lt 23'
1+21	18"	Ash Tree			Lt 10'
1+00	1179.0	Av Gr			
0+96	Pine	Mark	Pole		Lt 51'
				1178.5 Av Gr	Lt 70'
0+65	X-Sec			1178.9 Ebl	~ 56'
				1179.4 BK	~ 50'
				HW	~ 13'



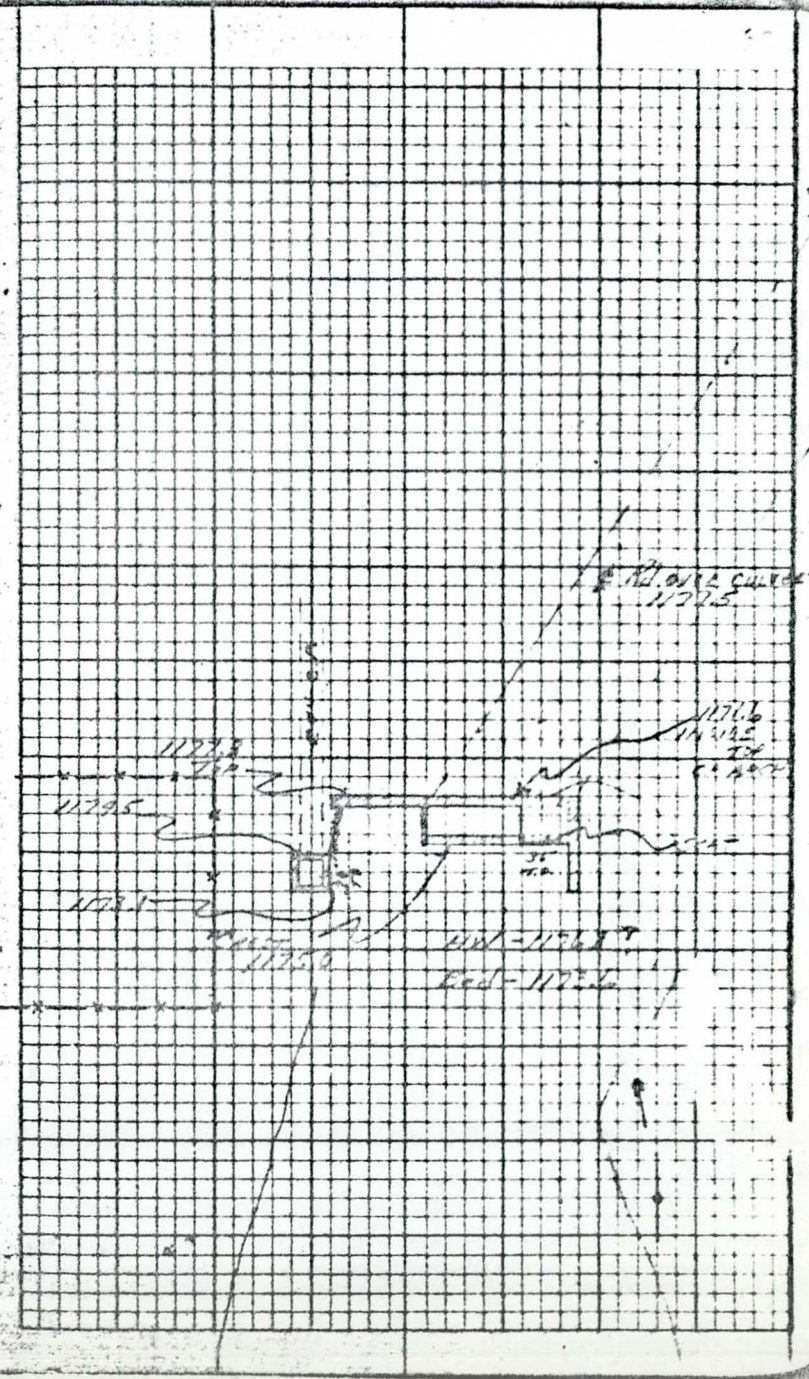
14+00	1177.7	AvGr	
13+21	14" C.P. drain From E		Lt 45
NOTE: SCALE CHANGES TO 1"=20' AT 13+21			
13+00	1177.2	AvGr	
12+20	Tel Pole		Lt 10'
12+20	11798.6	TBM Nail Tel Pole E. Rd	
12+00	X-Sec	1177.5	AvGr Lt 75'
		1179.9	℄ Rd ✓ 60'
		1179.3	BK ✓ 55'
11+00	1177.6	AvGr	HW ✓ 48'
10+00	1177.7	AvGr	
9+00	1177.8	AvGr	
8+00	1177.9	AvGr	
7+86	Tel Pole		Lt 10'
7+86	1180.36	TBM Nail Tel Pole E. Rd	
7+00	1177.9	AvGr	1178.0 AvGr 75'
			1180.5 ℄ Rd 62'
6+00	X-Sec		1180.1 BK 53'
			HW 48'



24+00	X-Sec				
23+00	1177.0	Av Gr			
22+00	1177.2	Av Gr			
21+00	1177.6	Av Gr			
20+98	Tel Pole				Lt 13'
20+98	1178.4	TBM	Nail used	Tel Pole	E³ Rd
20+00	1177.6	Av Gr			
19+00	1177.6	Av Gr			
18+00	X-Sec				
17+00	1176.8	Av Gr			
16+58	Tel Pole				Lt 11'
16+58	1179.20	TBM	Nail	Tel Pole	E³ Rd
16+00	1176.5	Av Gr			
15+00	1177.3	Av Gr			

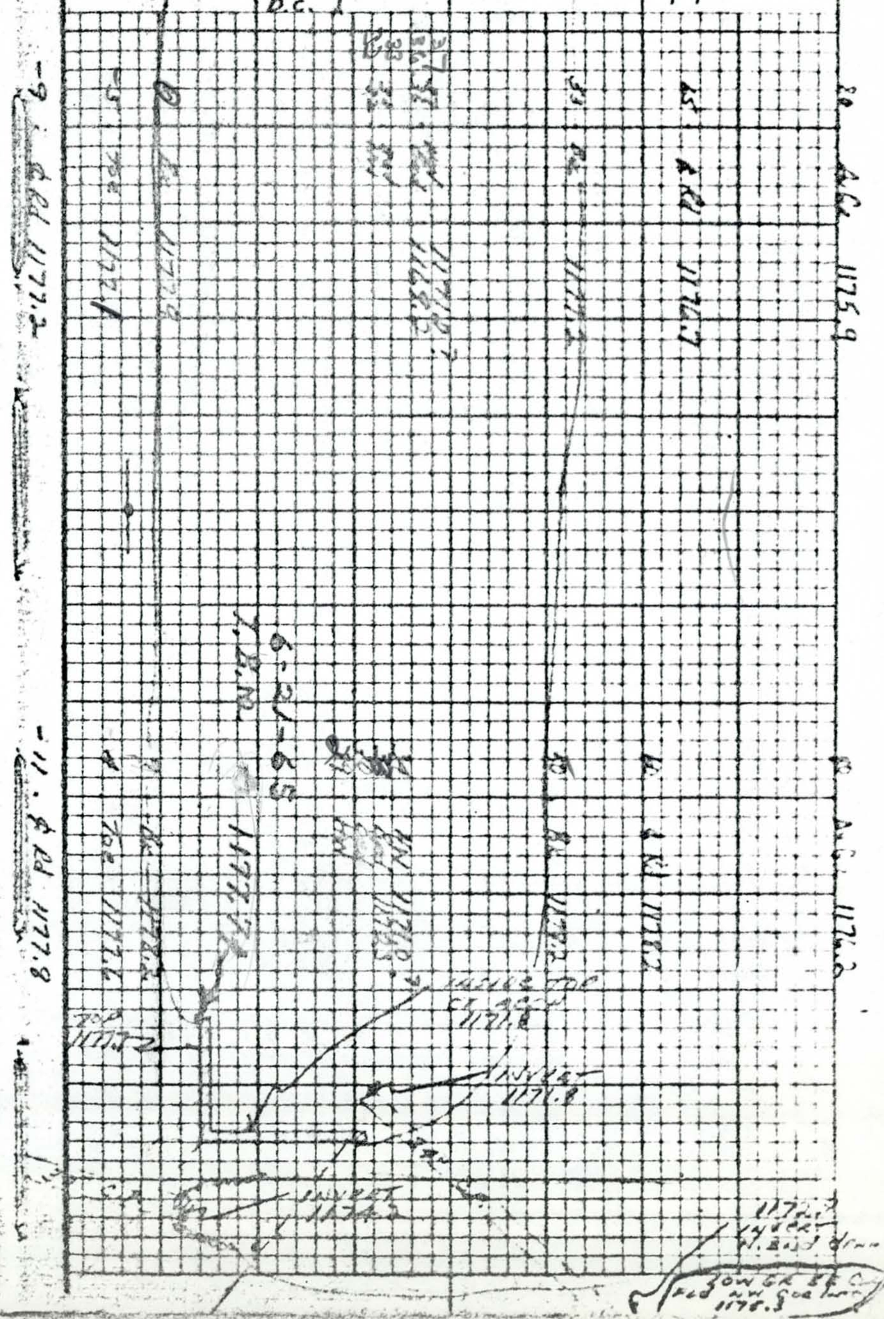


26+48	BASELINE CHANGES TO 12° TO W				
26+12	1177.9	TBM	~~PWC~~ GONE Pole	Pole	W.S. Rd
26+12	START 12' Arched Conc			CULV TO	SW Lt 25'
26+02	START SPILLWAY + T.O. STR				Lt 24'
26+00	1176.2	AvGe			
25+64	NW Cor Well Site Fence				Lt 60'
25+59	Down Guy				Lt 16'
25+37	Tel Pole				Lt 14'
25+00	1176.2	AvGe			



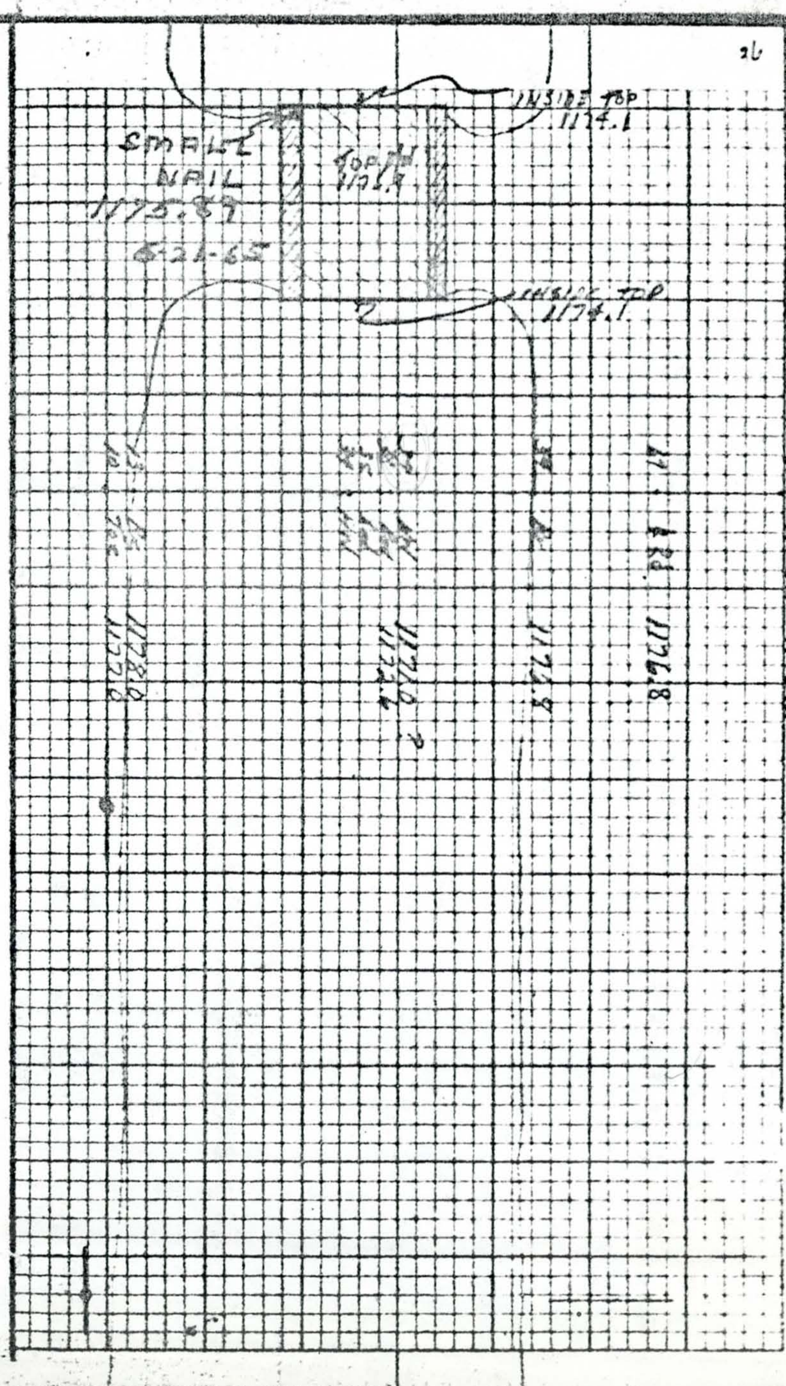
32+00		X-Sec			
31+00	1175.8	Av Gr			
30+00	1175.9	Av Gr			
29+14	Pwr Pole				Rt 7
29+00	1175.9	Av Gr			
28+00	1176.2	Av Gr			
27+30	X-Sec				
26+88	24" C.P. drain from N.W.				Rt 31'
26+84	S= 12' Arched Conc. Culv fr N.				Rt 20'
26+81	30" C.P. Crosses Rd from E				Rt 12'

B.C. J.C. D.C. 3/3/59



39+90	5th Conc Bridge				Rt 28'
39+70	Start Conc. D/W Bridge				Rt 28'
39+00	1175.1	AvGr			
38+00	X-Sec				
37+00	1175.4	AvGr			
36+28	Pwr Pole				Rt 10'
36+00	1175.5	AvGr			
35+00	1175.6	AvGr			
34+00	1175.8	AvGr			
33+00	1175.7	AvGr			
32+58	1178.50	TBH Nail GONE Pwr Pole			Rt 8'

26

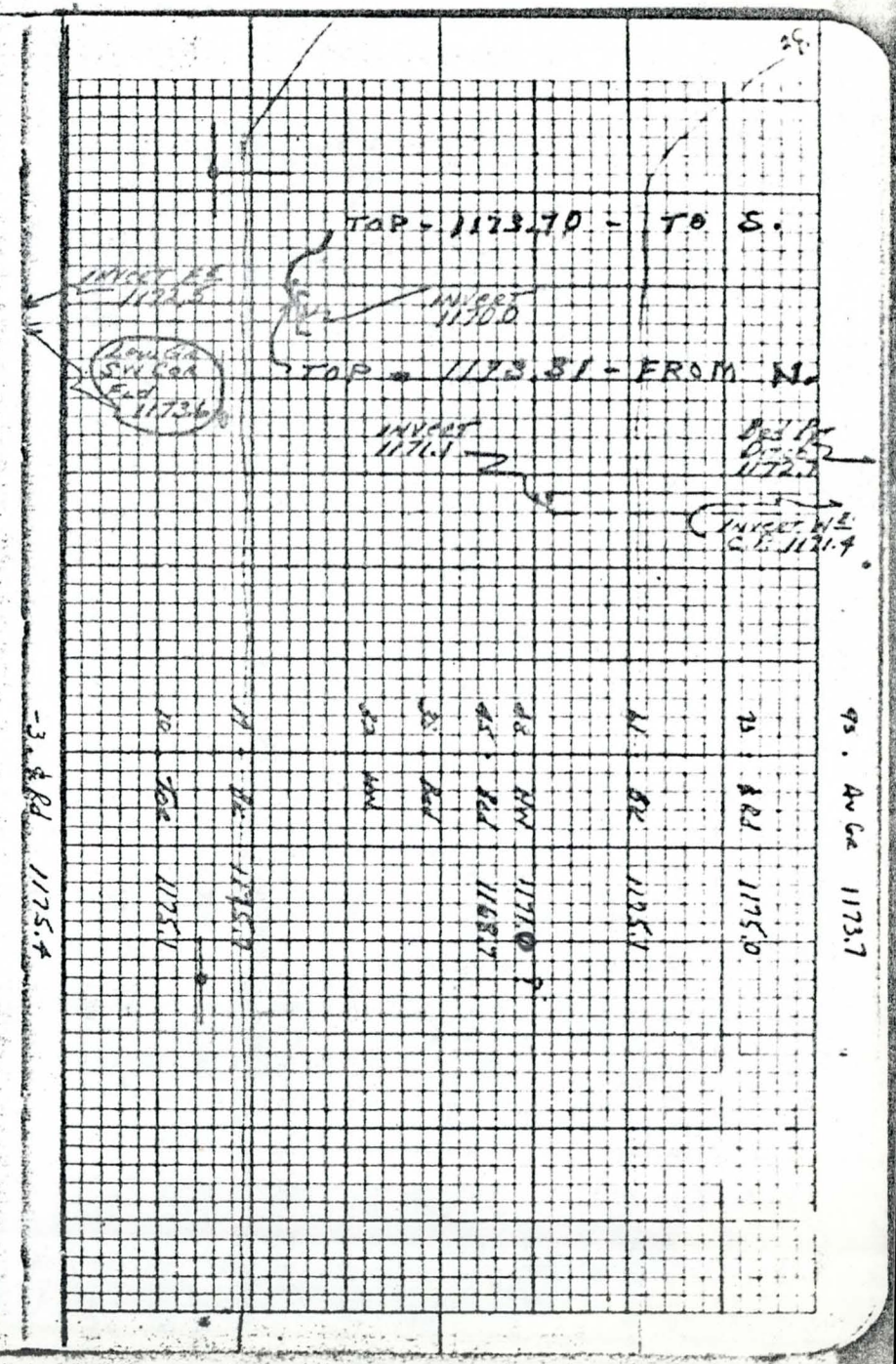


47+00	1174.4	Av Ge			
46+75	1178.34	TBH	GONE Pwr Pole		R- 16'
46+00	1174.5	Av Ge			
45+00	1174.7	Av Ge			
44+00	X-Sec				
43+32	Pwr Pole				Rt 13'
43+00	1175.0	Av Ge			
42+00	1175.0	Av Ge			
41+00	1175.1	Av Ge			
40+00	1175.2	Av Ge			
39+97	1178.30	TBH	GONE Pole		R- 11'

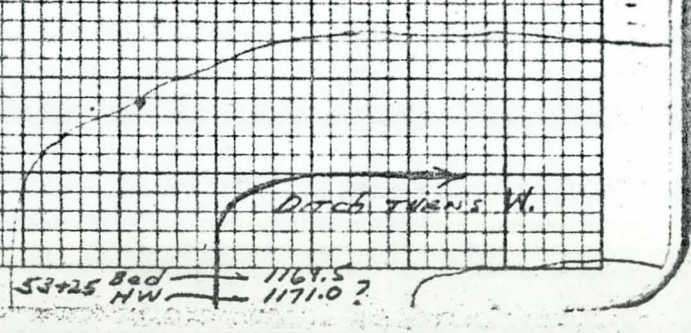
-3. Rd 1176.4

85. Av Ge 1174.9

53+05	1176.02	GONE TBH	Pwr Pole		Rt 16'
53+00	ditch	STARTS TO TURN TO W			—
52+94	24" C.P.	drain fr E. Rd			Rt 25'
52+86	Down Guy				Rt 17'
52+81	24" C.P.	drain fr Rt Ditch			Rt 52'
52+00	X-Sec				
51+00	1173.8	Av Ge			
50+11	Pwr	Pole			Lt 15'
50+00	1174.0	Av Ge			
49+00	1174.2	Av Ge			
48+00	1174.3	Av Ge			



	1177.88	BK.	W-278	- PG.	4
	1177.49	NAIL	S. PWR. P.	E.	
		RD.	225.35.		
53+47	Lt & Lt-Ch	LOOKING TO W	—		



BOOK W-278

SURVEY OF GILA DRAIN FROM 22E. 3½ S. TO 20½E. 6 S.

BASELINE IS ℄ DITCH

T.B.M. 1173.20 +℄ X-WALK OVER T.O. NE STILLING BOX AT PUMP 21½ E. 4 S. S RAY RD. SEE BK.- W.- 219 PAGE 38.

R.M.
D.P.
K.M.

Sec 22 T 1S R 4E

53+00

Date 6-VII-65 Completion date
CSR number Job number 319
Remarks SURVEY FOR CLEANING GILA DRAIN
Book number W-278 By
Survey by R.M. Date completed
Date to drafting Date completed

W.O. # 87-0007-652-114

PLOTTED BY O.P.P.
DATE 8/6/65
JOB NO. 319
DWG. NO. B-112-175.1

B-112-175.1

	T.B.M. ELEVATIONS				
53+06	1177.88	NAIL	S. PWR. P. E. RD.		- P.I. E. 3½ S.
57+13	1179.96	NAIL	S. PWR. P. N.		- DITCH PT. 33 FROM ℄ DITCH
61+34	1177.63	WOOD	STK. E. DITCH		
68+23	1176.46	"	"	"	"
73+05	1175.33	NAIL	E. R.R. TIE	COR. P.	42' W. = W. DITCH
75+31	1175.32	WOOD	STK. E. BK.		
81+81	1173.31	WOOD	STK. E. BK.		
88+55	1173.20	+ & X.	WALK OVER TO. NE		- STILLING BOX 21½ E. 4 S.
94+00	1173.51	WOOD	STK. E. BK.		
100+00	1173.61	"	"	"	"
106+00	1172.51	WOOD	STK. E. BK.		
112+00	1170.70	WOOD	STK. E. BK.		
118+00	1170.14	WOOD	STK. E BK.		
119+51	1167.32	SMALL	NAIL W. WINGWALL		W. DITCH 21½ E. 4½ S.
124+00	1169.27	WOOD	STK. E. BK.		
130+00	1166.28	WOOD	STK. E. BK.		
136+00	1167.74	WOOD	STK. E. BK.		
142+00	1167.96	WOOD	STK. E. BK.		
148+00	1165.88	WOOD	STK. E. BK.		
151+93	1167.07	NAIL	N. TRANS. P. 29' S.		- ℄ DITCH 21 E 5 S.
157+92	1164.36	NAIL	N. PWR. P. 12' N. ℄		- DITCH S. RD.
T.B.M.	1164.37	NAIL	N. PWR. P. N. SUB		- STATION S. RD. 20¾ E. 5 S.
168+57	1164.05	WOOD	STK. E. BK.		
175+71	1163.23	WOOD	STK. E. BK.		
182+71	1162.96	WOOD	STK. E. BK.		

T.B.M. ELEVATIONS

189+06	1162.15	WOOD	STK.	E. BK.
190+72	1160.72	NAIL	S.E. PWR. P. N.S. RD. TO E.	— 90' E. ℄ DITCH 20¾ E. 5.5 S.
193+48	1160.61	WOOD	STK.	W. BK.
200+28	1159.76	WOOD	STK.	W. BK.
206+30	1159.29	WOOD	STK.	W. BK.
212+35	1157.00	WOOD	STK.	W. BK.
218+40	1157.25	WOOD	STK.	W. BK.
T.B.M.	1155.29	SMALL	NAIL	S.E. E. CONC. — BRIDGE ABUTMENT S. FENCE E. W. 20½ E. 6 S.

57+50		DITCH STARTS TURN TO S.W.
T.B.M. 57+13	1179.96	NAIL S.S. PWR. P. N.S. DITCH RT. 33
53+85		X - SEC.
53+44		℄ OF DITCH TO W.
T.B.M. 53+06	~~1177.49~~ 1177.88	~~SURVEY FROM N. BK. W158~~ NAIL S.S. PWR. P. E.S. RD. 22 E. 3½ S.
53+00		DITCH STARTS TURN TO W.

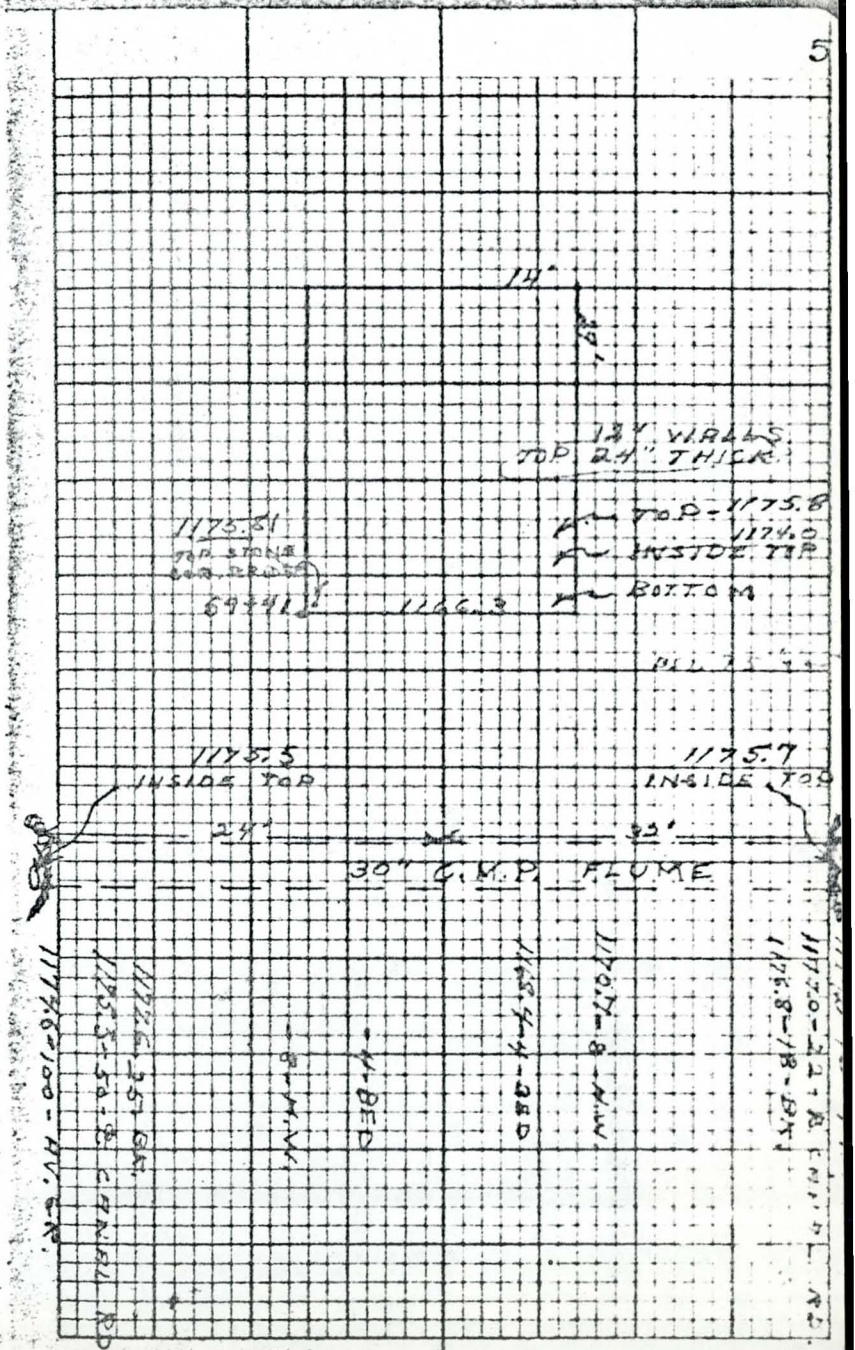
CONTINUED FROM PRINT B-112-40.7

BK. W-158 PP. 34-39

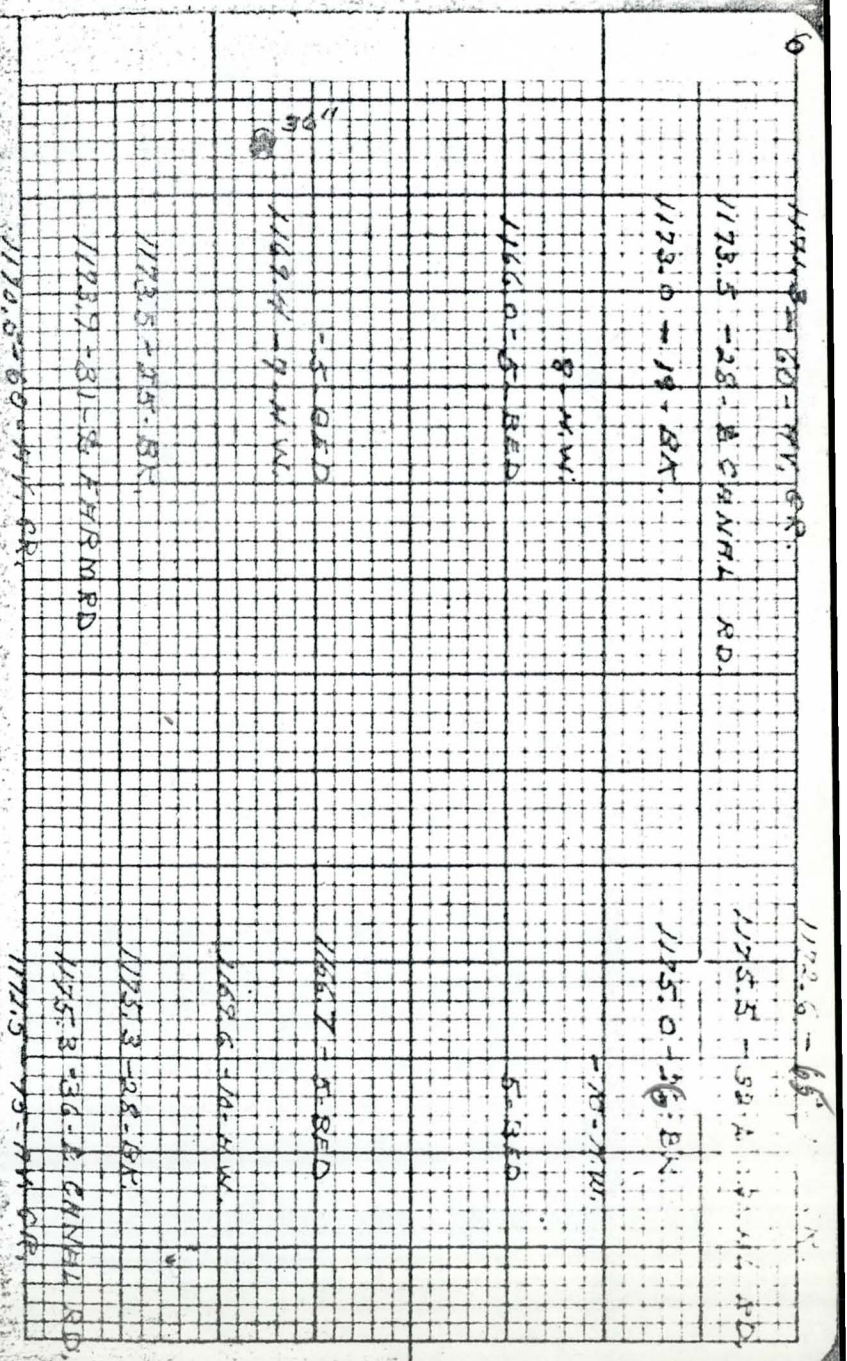
JOB # 2496

1174.3 - 60 - HY. GR. - (YARD)
1175.1 - 43 - ℄ FARM D/W
1174.4 - 16 - BK.
1172.9 - 8 - M.W.
1170.0 - 4 - BBD
- 4 - BBD
- 10 - M.W.
1176.2 - 18 - BK.
1178.0 - 38 - ℄ GRAVEL RD.

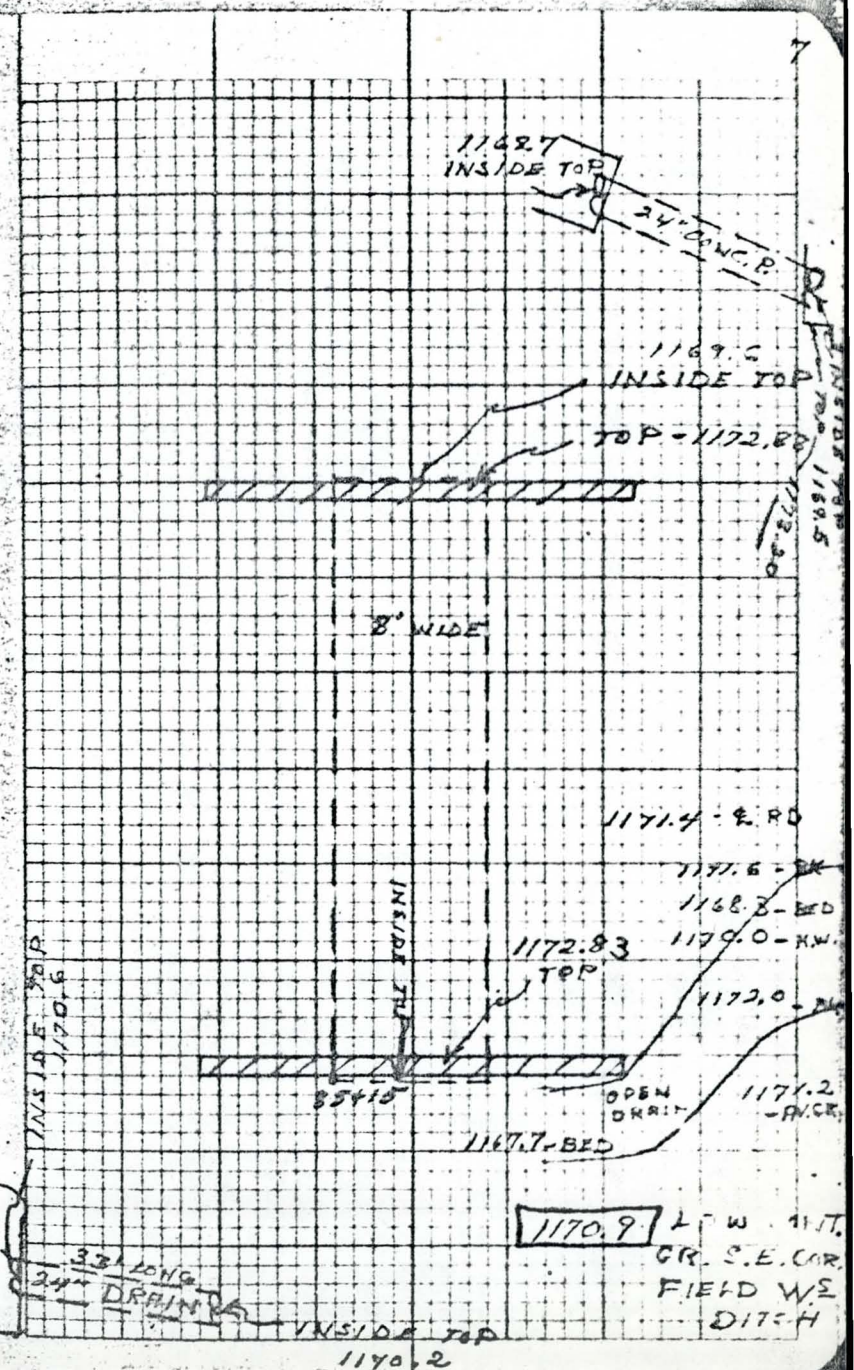
~~T.B.M.~~ 61+34	1177.63	WOOD	STK. E. BK.		
59+70		S.W. END	BRIDGE		
59+41		START	CONC. D/W. BRIDGE		
59+40		END CURVE	DITCH S.W.		
59+34		℄ 30" C.M.P. FLUME OVER	DITCH		
59+00		X-SEC.			
58+25		℄ CURVE	TO S.W.		



86+74		C. W. T.			LT. 7
86+00		X-SEC.			
T.B.M. 81+81	1173.31	WOOD	STK.	E. BK.	
T.B.M. 75+31	1175.32	WOOD	STK.	E. BK	
T.B.M. 73+05	1175.33	NAIL	E. E. R.R. TIE CORP.		RT. 41
72+00		X-SEC.			
T.B.M. 68+23	1176.46	WOOD	STK.	E. BK.	



88+47		24" DISCHARGE P. FROM PUMP RT. 10	
87-96		S.E. BOX. CULV. SEC. 27	
87+50	1171.7	℄ RAY RD. 21½ E. 4 S. SEC. 22	
87+15		START CONC. BOX CULV. UNDER RD.	
		1170.9 - ℄ RD.	1170.3 LOW CONT. GR. S.W. COR. FIELD EE. DITCH
		1172.0 - BK	
		1168.6 - BED	
87+07		24" DRAIN FROME	
		1169.8 - H.W.	
		1171.7 - BK	
		1170.5 - H.W. GR.	



1169.5 – 80 – HY. GR.

1171.3 – 28 – ℄ CANAL RD.

1171.1 – 19 – BK.

– 8' – H.W.

– 5 – BED

1165.0 – 5 – BED

1167.4 – 8 – H.W.

1172.0 – 25 – BK.

1172.1 – 31 – ℄ RD.

1169.7 – 65 – HY. GR.

1170.7 – 100 – HY. GR.

1171.3 – 35 – ℄ OLD CANAL RD.

1171.8 – 18 – BK.

– 8 – H.W.

– 5 – BED

1165.3 – 5 – BED

1167.9 – 8 – H.W.

1172.9 – 26 – BK.

1173.0 – 34 – ℄ RD. CANAL

1170.6 – 75 – HY. GR.

X – SEC.

102+00

T.B.M.

100+00 1173.61 WOOD STK. E. BK.

T.B.M.

94+00 1173.51 WOOD STK. E. BK.

89+00

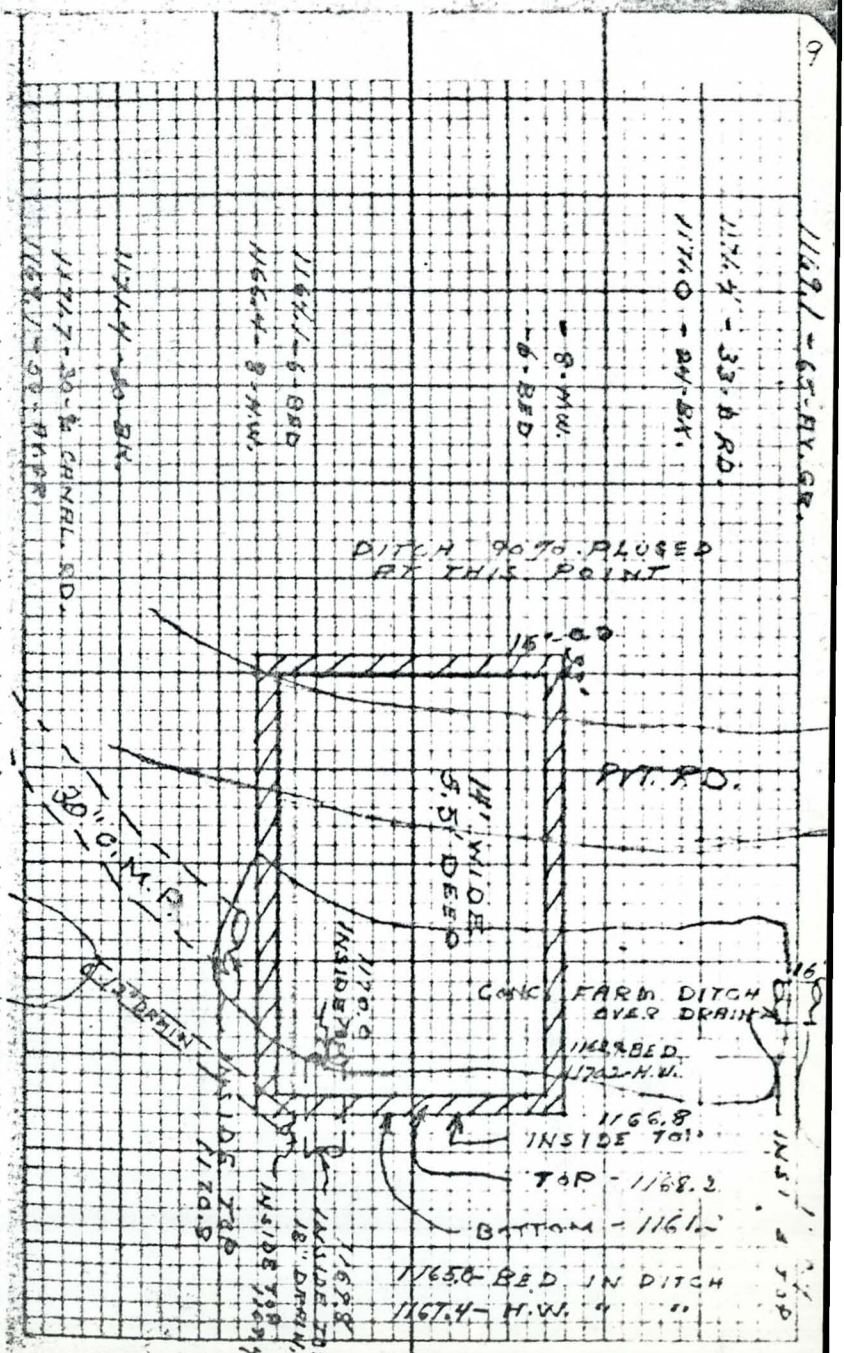
T.B.M.

86+55 1173.20 + ℄ X WALK OVER

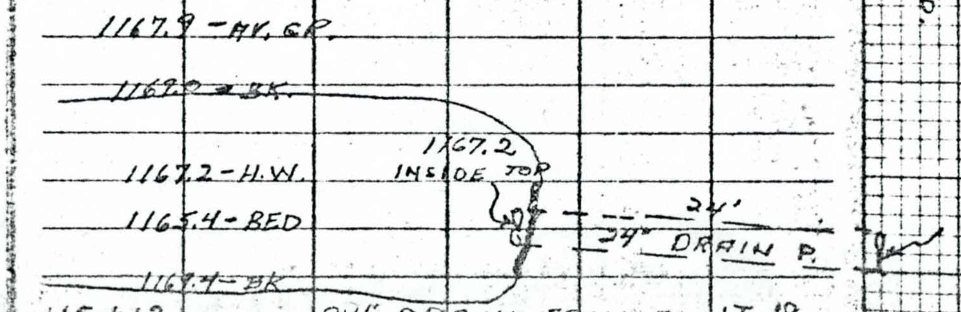
T.O. N. ℄ DISTILLING BOX

ET PUMP 21℄ H.S.

T.B.M. 106+00	1172.51	WOOD STK. E. BK.			
104+00		X-SEC.			
102+50		S.W. END BRIDGE			
102+45	1169.2	LOW CONT. GR. S.W. COR. FIELD E. DITCH			
102+17		START CONC. BRIDGE			



T.B.M.					
118+00	1170.14	WOOD	STK	E. BK.	
116+00		X-SEC.			

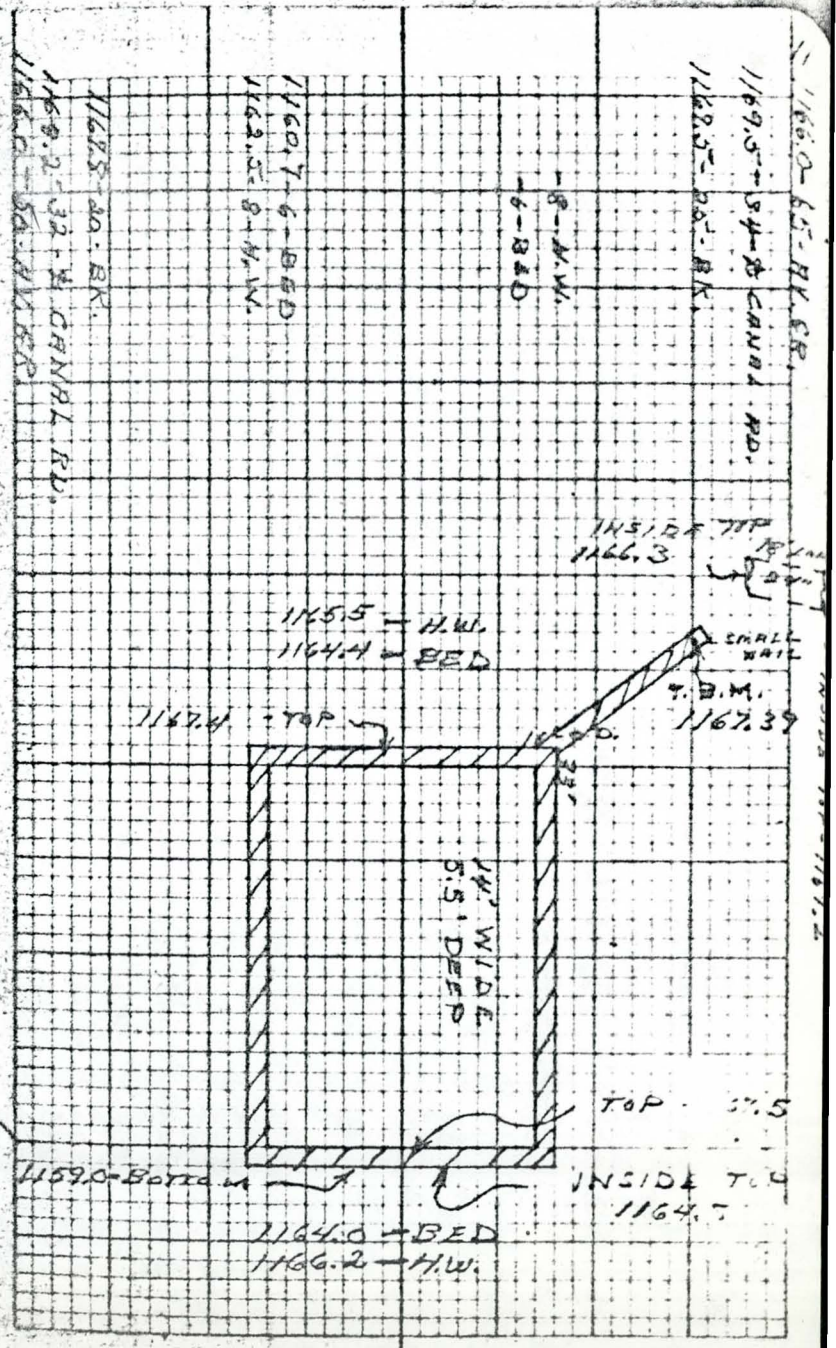


115+12		24" DRAIN	FROM E.		LT. 19
1167.5 - AV. GR.					
114+65	1167.3	LOW CONT.	GR.	FIELD S.E. COR.	LT. 50
113+99		THREE	T'S	ONE	
			BUNCH		LT. 8
T.B.M.					
112+00	1170.70	WOOD	STK.	E. BK.	

1167.5 - 50 - AV. GR.
1169.7 - 31 - ℄ CANAL RD.
1169.7 - 20 - BK.
1166.0 - 10 - H.W.
1164.7 - 8 - BED
1164.7 - 8 - BED
1166.0 - 10 - H.W.
1169.9 - 33 ± BK.
1169.9 - 33.2 CANAL RD.
1167.9 - 60 - AV. GR.

8" EACH

130+00		X-SEC.			
T.B.M. 124+00	1169.27	WOOD	STK.	E. BK.	
119+54		24" DRAIN	FROM	W.	
T.B.M. 119+51	1167.32	SMALL	NAIL	W'LY	WINGWALL
119+48		S.W. END	BRIDGE		
119+15		START	CONC.	BRIDGE	
119+05	1167.2	LOW CONT.		S.E.	COR.
		FIELD	W.S.	DITCH	



149+97		24" DRAIN. P. W. BK. RT. 15'
149+50	1162.8	LOW CONT. GR. S.W. COR. FIELD W.S. DITCH E.S. RD.
T.B.M. 148+00	1165.88	WOOD STK. E BK.
146+26		UNDER GROUND TELE. CABLE ACROSS DITCH.
143+00		X-SEC.
T.B.M. 142+00	1167.96	WOOD STK. E BK.
T.B.M. 136+00	1167.74	TOP WOOD STK. E.S. DITCH
T.B.M. 130+00	1168.28	TOP WOOD STK. E BK.

1/1 TOP - 1165.5

INSIDE TOP 1162.3

TELE. CABLE

1167.3 - 19' BK.

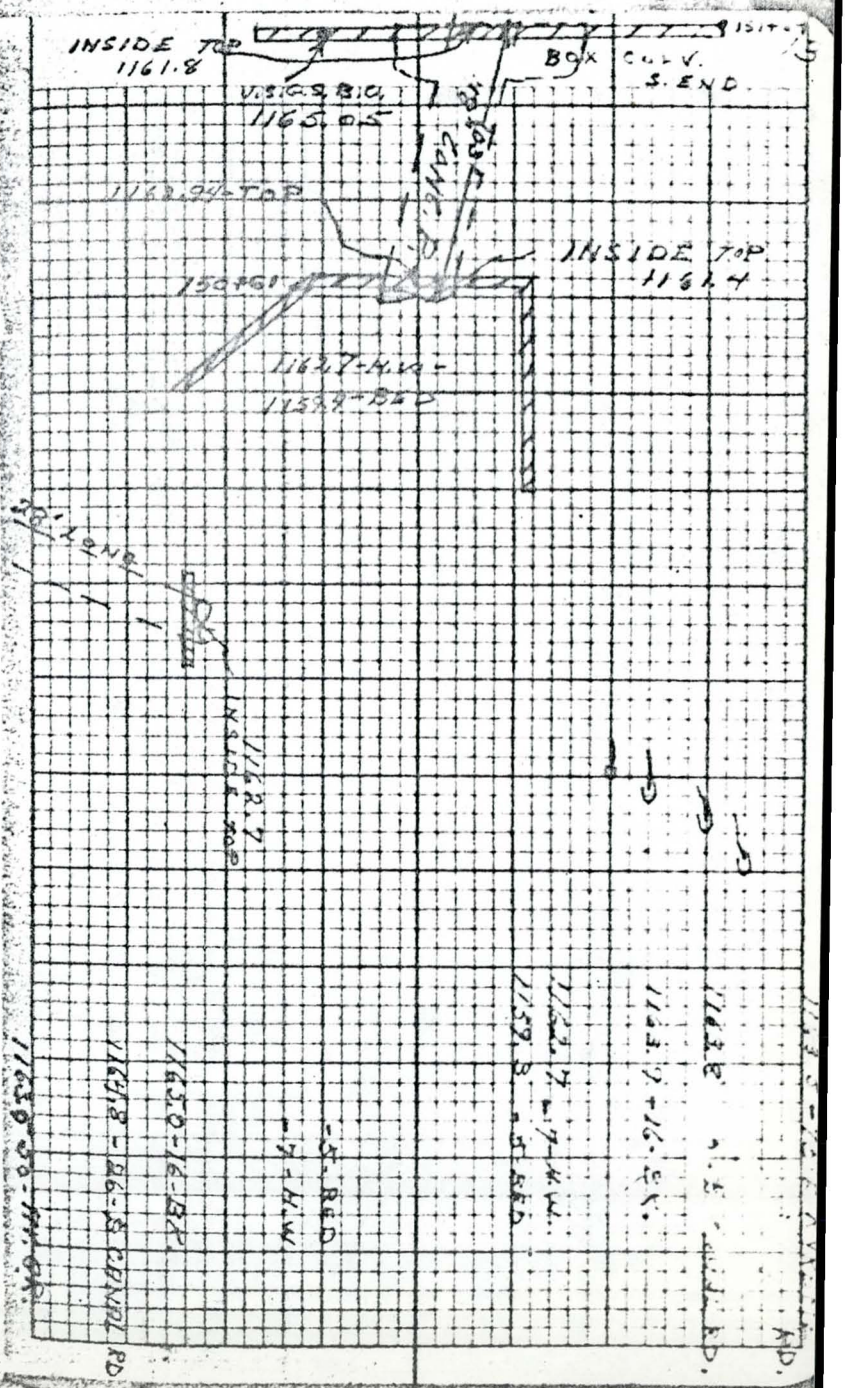
1167.3 - 38' E RD.

1167.8 - 18' BK.

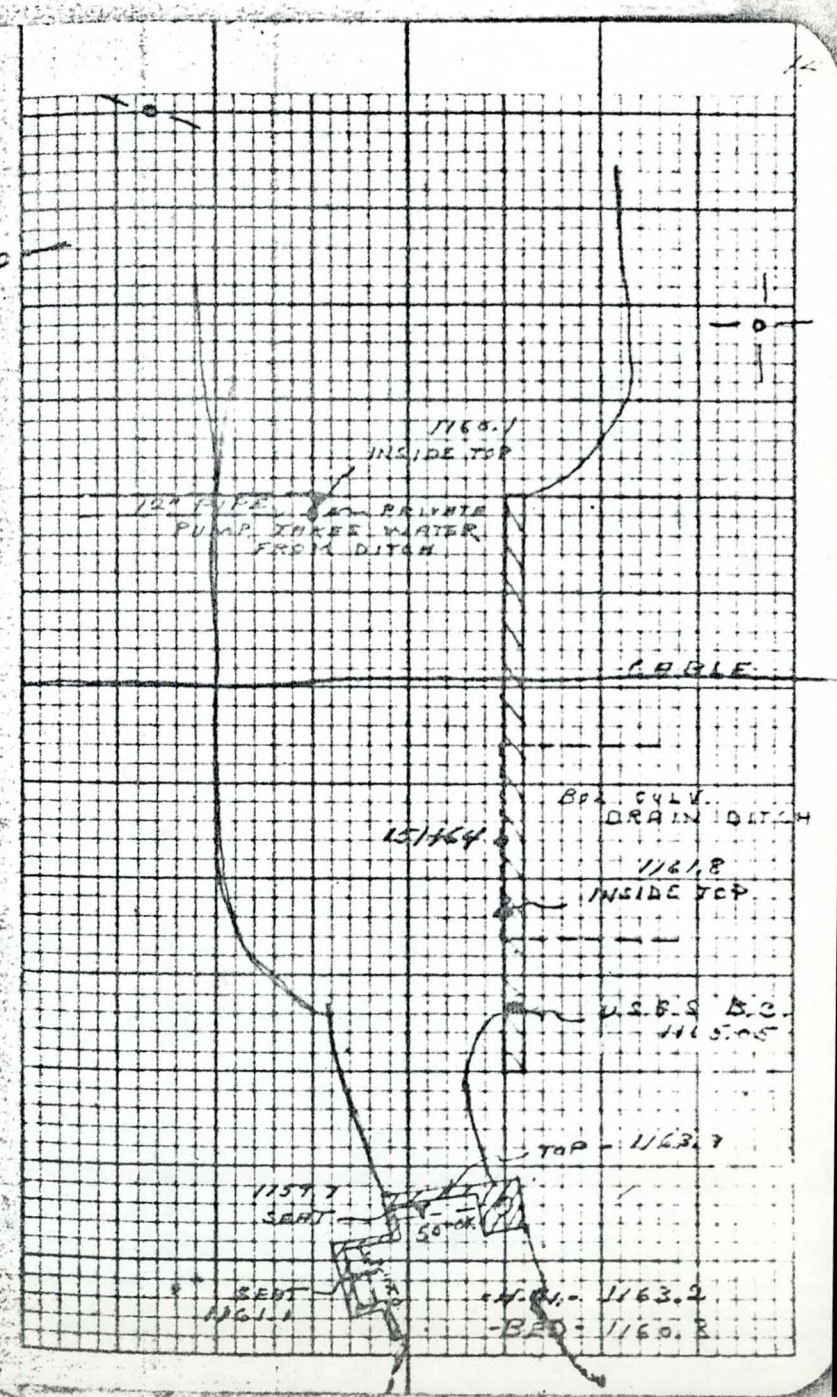
1167.3 - 38' E RD.

1168.2 - 60' BK. RR.

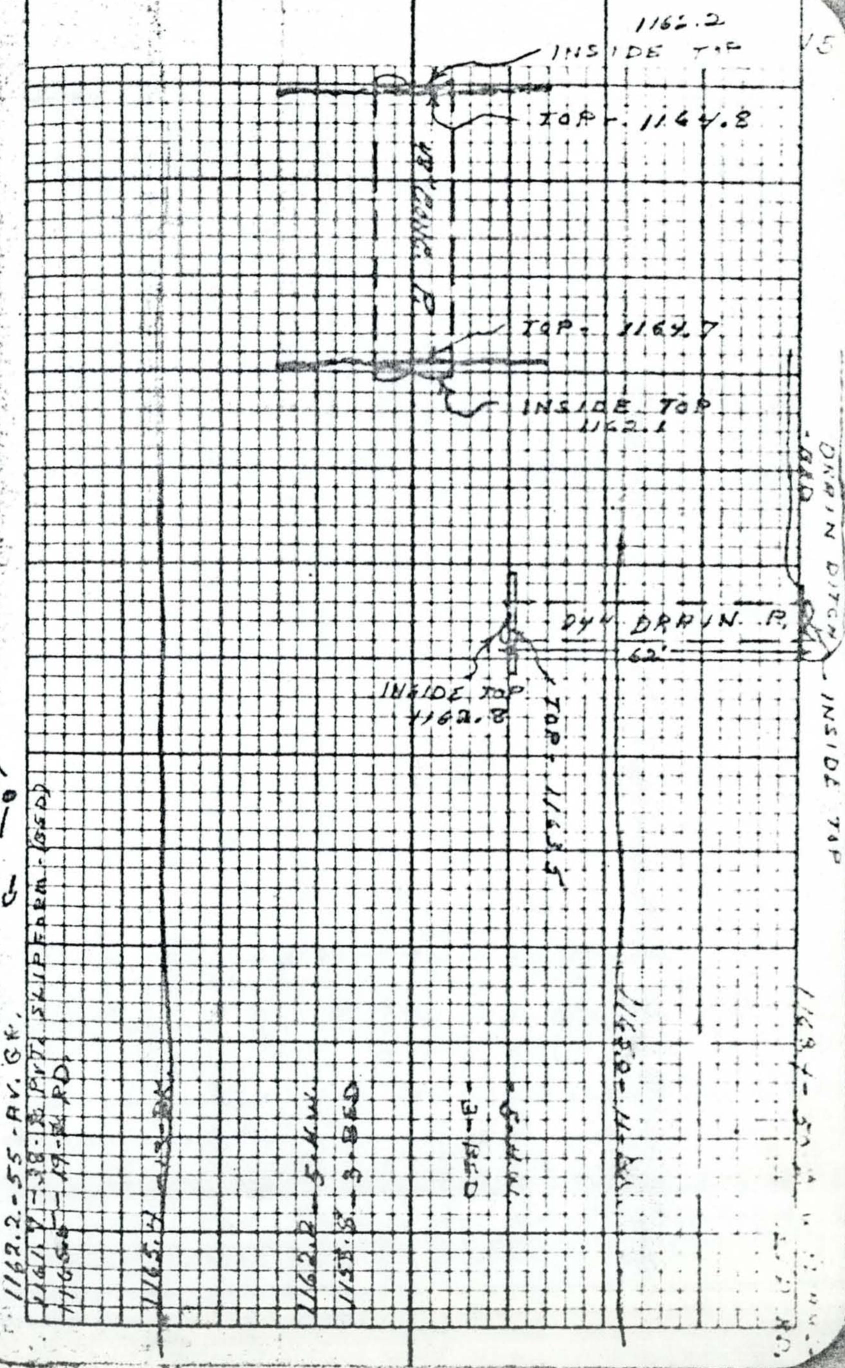
THIS BACK	BOX CULV. IS 6.5' DEEP INSIDE IT LOOKS		LIKE 4.5' DEEP	AT S.E.	BUT
151+11	1163.6	E. WILLIAMS FIELD RD			
		SEC. 27			
150+61		START 48" CONC. P.			
		BARR DITCH 1161.9 - BED		1163.8 INSIDE TOP	
1162.7	LOW CONT. ER. S.W. COR. FIELD E. DITCH				
150+54		24" DRAIN P. FROM W.			LT. 11
150+42		DOWN GUY			RT. 10
150+36		DOWN GUY			RT. 12
150+34		DOWN GUY			RT. 15
150+31		DOWN GUY			RT. 17
150+10		X-SEC.			



151+98		PWR.	P.		LT. 13
~~T.B.M.~~					
151+93	1167.09	NAIL N.	TRANS.	P.	LT. 29
151+83		PWR.	P.		RT. 18
151+77		12" PVT. PUMP INTAKE		PIPE	LT. 5
151+73		UNDERGROUND		CABLE	
151+64		℄ DRAIN DITCH			
		TURNS STRAIGHT W.			
		36" T.C. TO S.		#6-9-4-55	
		SEC. 33			

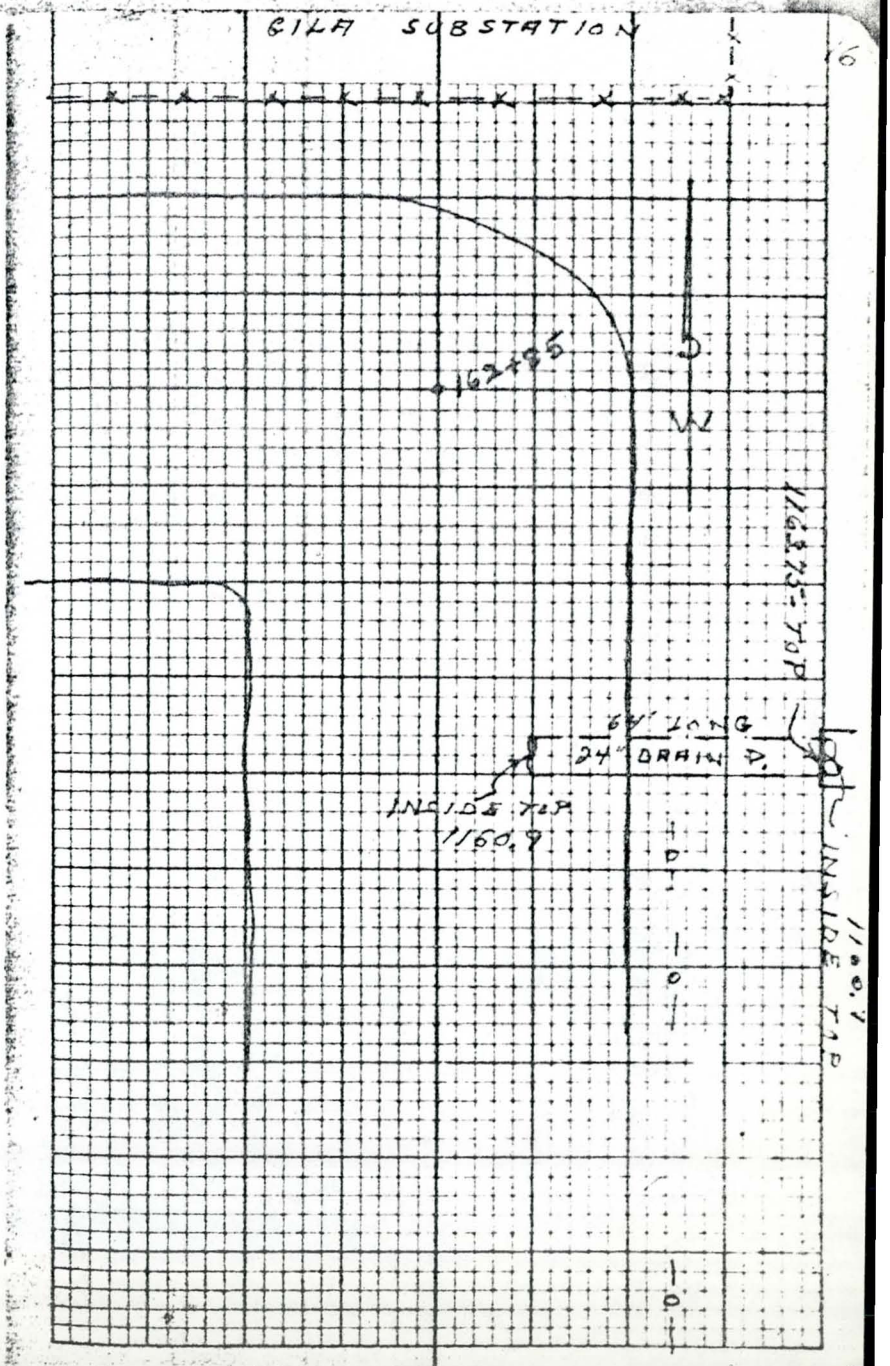


154+17		W.E. 48" CONC. P.	
153+97		48" CONC. P. D/W.	
153+50	1162.7	LOW CONT. GR.	
		GROVE N.E RD.	
153+36		24" DRAIN	RT. 5
152+44		SERV. P.	LT. 33
152+40		DOWN GUY	LT. 27
152+00		X-SEC.	

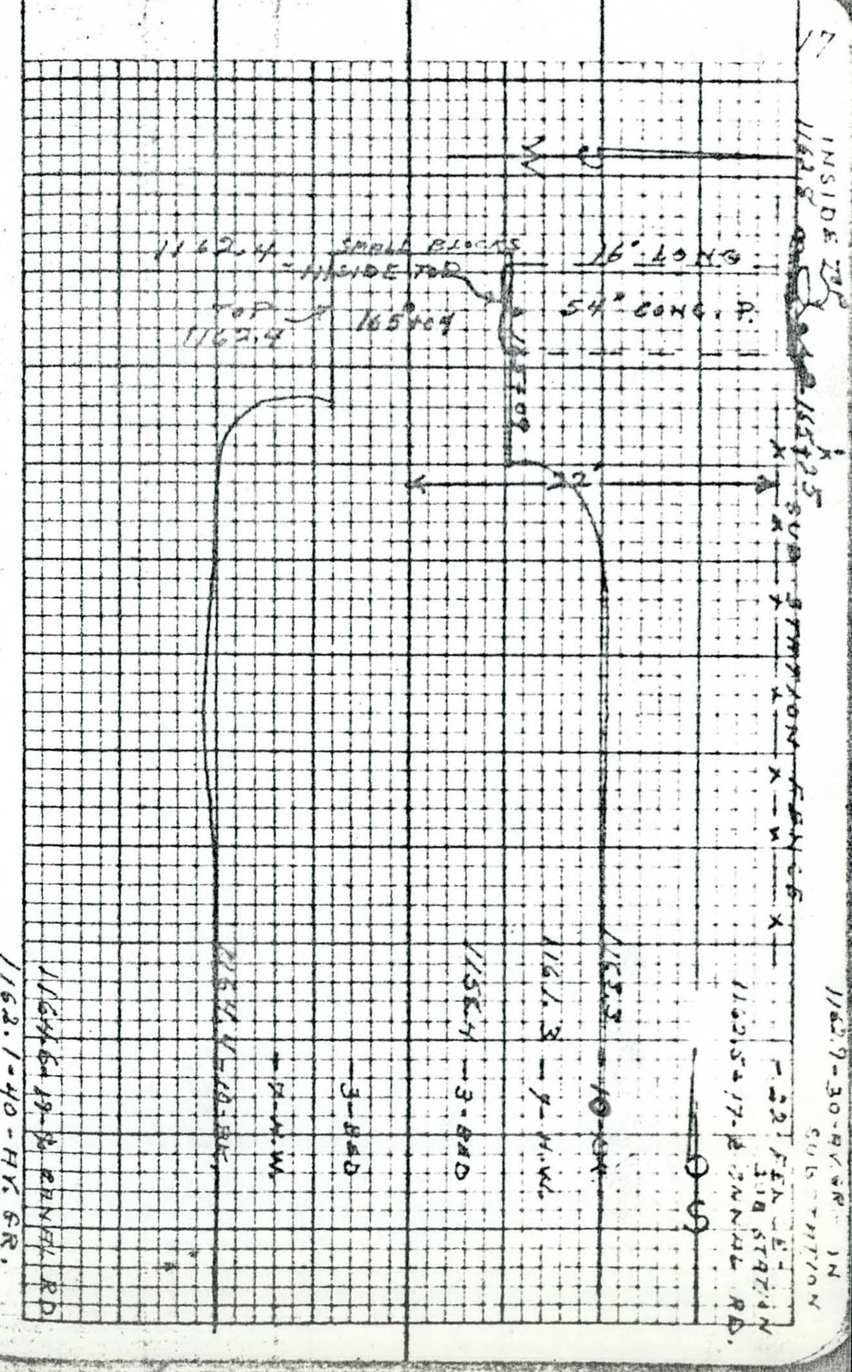


1164.4°

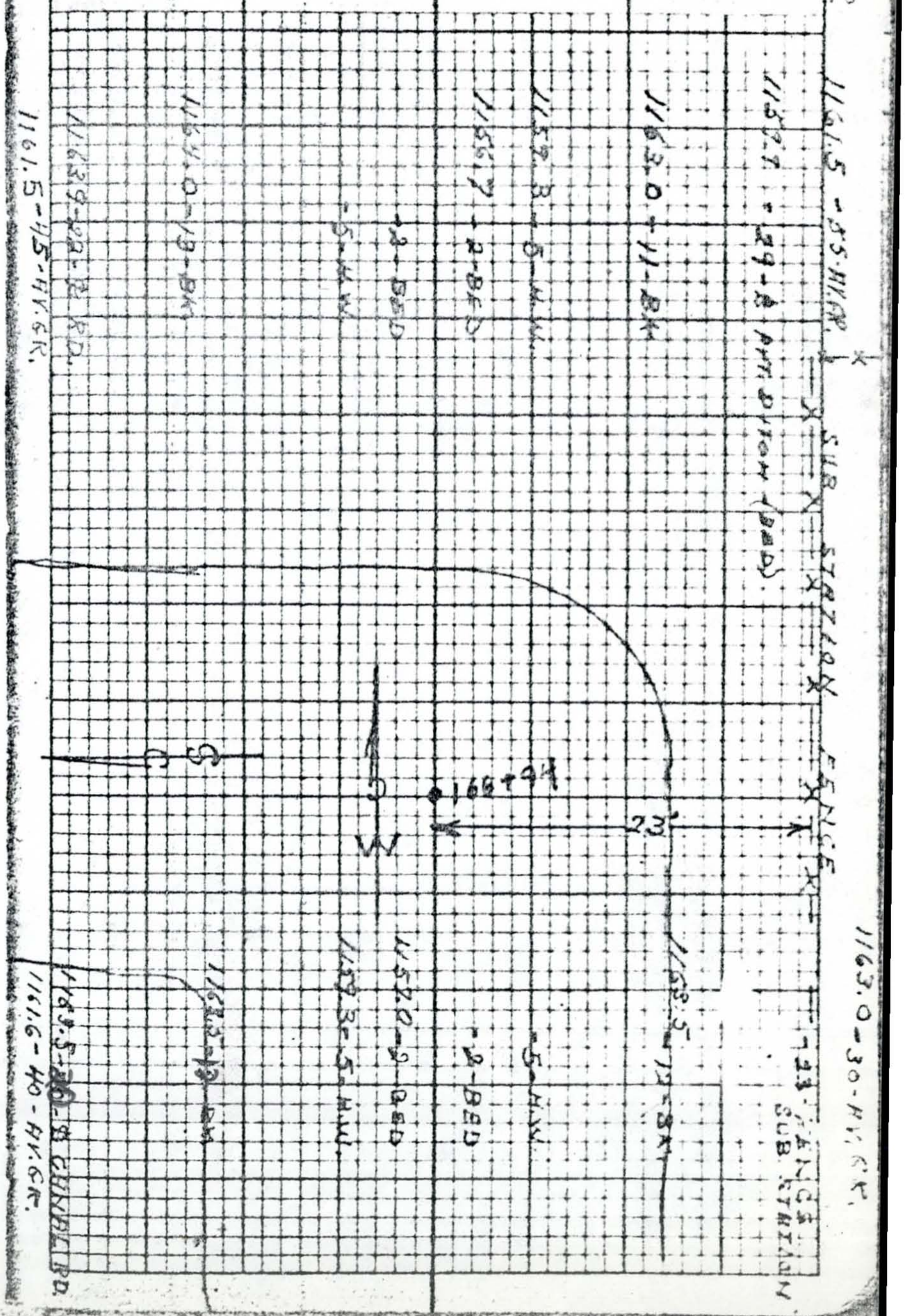
T.B.M.	1164.37	NAIL	N^{S} PWR P		
		N^{S} SUB STATION S^{T} RD.			
162+85		& DITCH TURNS S.			
162+78	1162.8	LOW CONT. GR. FIELD		N^{S} RD.	
162+78		24" DRAIN P. FROM			
		N^{S} WILLIAMS FIELD RD.		RT. 5	
160+96		PWR P.		RT. 12	
~~T.B.M.~~					
157+92	1164.36	NAIL	N^{S} PWR P.	RT. 12	
155+66		PVT. DITCH TURNS S. & LT. 88			
154+88		PWR. P.		RT. 12	



165+25	W.E. 54" CONC. P.
165+09	START 54" CONC. P. D/W.
165+04	℄ DITCH TURNS W.
164+82	SUB STATION FENCE TURNS W. RT. 22
164+00	X - SEC.



T.B.M.				
168+57	1164.05	WOOD	STK.	E. BK.
168+00		X-SEC.		
166+94		℄ DITCH	TURNS	S.
166+00		X-SEC.		
165+25		W.E. 54" CONC. P.		



				1159.3 Low GR.	
189+40		12" DRAIN P.			LT. 5
T.B.M.					
189+06	1162.15	WOOD STK. E. BK.			
T.B.M.					
182+91	1162.96	WOOD STK. E. BK.			
181+00		X-SEC.			
178+85	1159.1	DRAIN W. BK. (BED)			
178+60	1160.1	LOW CONT. S.E. COR. FIELD		W^E DITCH	
175+71	1163.23	WOOD STK. E. BK.			
175+57		C.W.T.			RT. 5

12" DRAIN IN INSIDE TOP - 1158.7

THIS END COVERED

1161.2 - 19 BK.

1158.3 - 5 BK.

1155.5 - 3 BED

- 3' BED
- 5' BK.

1158.7 - 15 BK

1162.8 - 22 ± CANADA RD.

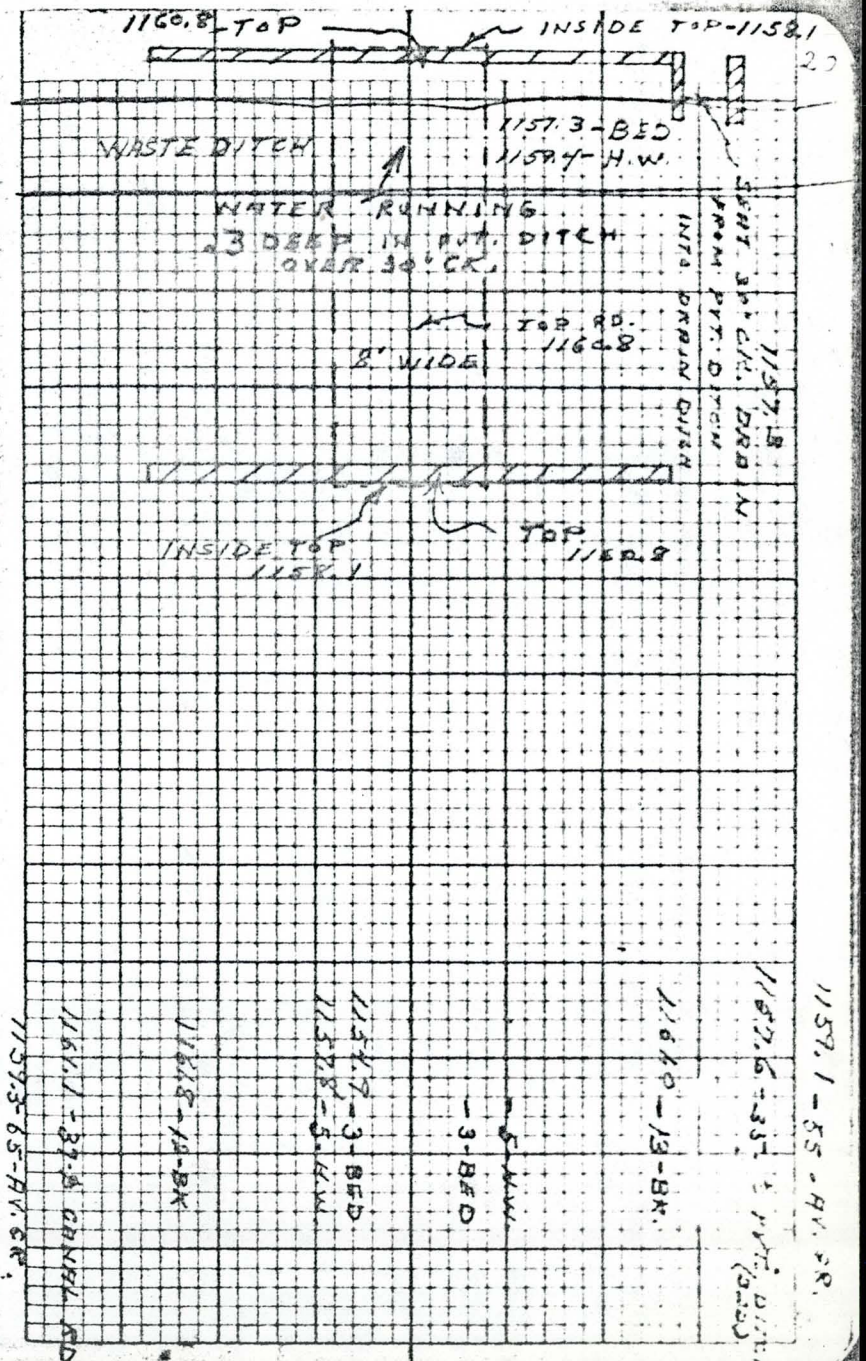
1160.6 - 30 ± BK. GR.

1159.0 - 30 ± PVT. DITCH (BED)

1159.9 - 75 - HV. GR.

18"

191+14		S.E. BRIDGE			
191+07		SMALL & DRAIN DITCH OVER DRAIN DITCH			
190+79		START CONC. BRIDGE P/W			
~~T.B.M.~~					
190+72	1160.72	NAIL S.S. PWR. P. N.S. RD. TO E. 9.0' E. & DITCH			
190+15		DITCH STARTS CURVE TO S.E.			
190+15		END PVT. DITCH RT. 35			
190+00		X-SEC.			



205+00		X-SEC.			
203+82		12" METAL DRAIN P.			LT. 17
203+78	1156.3	LOW CONT. GR.			LT. 56.5
200+28 T.B.M.	1159.76	WOOD	STK.	W. BK.	INSIDE TOP 1157.1
T.B.M. 193+42	1160.61	WOOD	STK.	W. BK.	
192+00		X - SEC.			
191+55		6" GAS P. (EL PASO)			
191+50		DITCH RUNS S.W.			

1156.2 0.5 - 41. GR.
1155.4 - 0.5 r ℄ PVT. DITCH
1150.0 - 35 ℄ RD.
1150.0 - 26 BK.
-10 - HW.
-8 - BED
1151.2 - 8 BED
1153.7 - 16 - HW.
1156.0 - 23 BK.
1158.5 - 31 ℄ RD
1156.5 - 55 - PVT. GR.

15" DRAIN INSIDE TOP 1158.4

℄ CANAL RD.
1159.0

1157.3 - 60 - HW. GR.
1160.1 - 38 - ℄ RD.
1161.1 - 29 - BK
-6 - HW.
4 - BED
1155.6 - 4 - BED
1157.3 - 6 - HW.
1163.0 - 15 BK.
1162.8 - 29 ℄ RD
1158.4 - 10 - HW. GR.

1158.1 6" GAS. P.

	1155.3 — AV. GR.				
	1155.4 — BK.				
	1152.3 — BED		INSIDE 24"		
	1154.0 — H.W.		1153.8		
	1154.7 — BK.		TOP		
	1154.3 — AV. GR.		1155.7		
224+54		24" DRAIN - CONC. P.		LT. 12	
T.B.M.					
218+40	1157.25	WOOD	STK.	W. BK.	
218+00		X-SEC.			
212+35	1157.00	WOOD	STK.	W. BK.	
210+00		PVT. DITCH	TURNS	W.	
T.B.M.					
206+30	1159.29	WOOD	STK.	W. BK.	

18" DRAIN
TOP 1154.6
1153.9 INSIDE TOP

1156.9 - 23 - BK.
1150.9 - 30 - E. RD.
-11- H.W.
-9- BED.
1153.6 - 11 - H.W.
1152.0 - 9 - BED
1155.3 - 23 - BK.
1157.6 - 61 - E. RD.
1154.7 - 65 - AV. GR.
1154.7 - 55 - AV. GR.

T. B. M.	1155.29	S.E. OF E. BRIDGE ABUTMENT S. FENCE E. + W SMALL MOU. 21½ E. 6S.			
224+94		IS STA. 0+00 AND FENCE LINE E. + W. BK. W-276. GILA DRAIN DITCH PAGES 1-8			
224+60		X-SEC.			
224+54	1153.9	LOW CONT. GR. S.W. COR. FIELD E. DITCH - DRAINS IN DRAIN DITCH FROM E.			

1153.9 - 60 - HV. GR.

1157.2 + 30 - R RD.

1157.4 - 24 - BK.

-12 - H.W.

-10 - BED

1157.0 - 30 - BED

1155.2 - 18 - H.W.

1154.4 - 24 - BK.

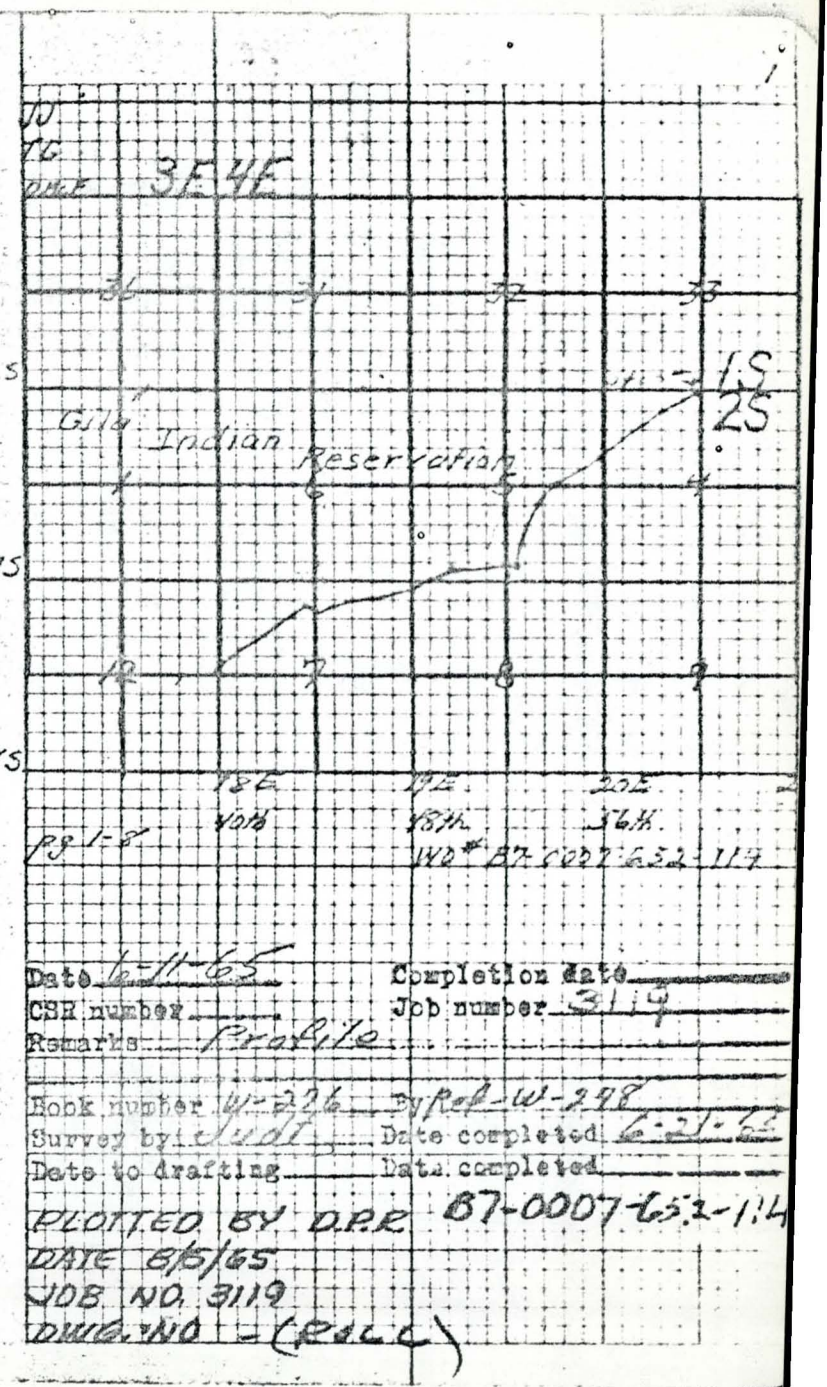
1154.2 - 33 - R RD.

1154.3 - 65 - HV. GR.

BOOK W-276

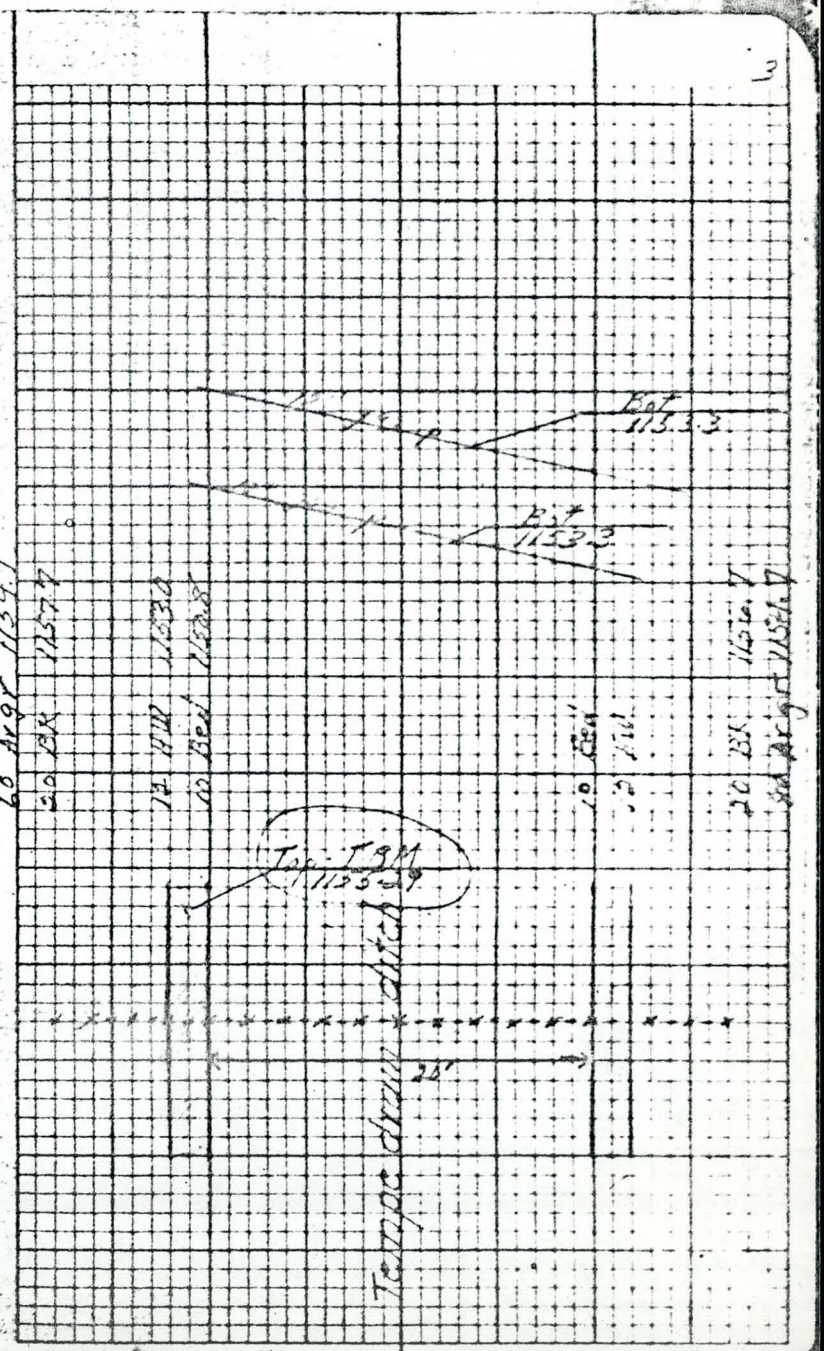
Profile Temple drain
from S¼ cor. Sec 33 T15S R4E
to W¼ cor Sec 7 T25 R4E

Survey from NE-Ref W-278
pg 1-23



	1164.37	Nail pwrp S^{s} pd 20¾ E - 5 S - Gila Sub			
	1160.77	Nail pwrp E^{s} Tempe Drain 20¾ E - 5½ S			
	1155.53	Nail in gate post W^{s} of ditch			
0+07	1155.29	Top hub & S^{t} - E^{s} of ditch 20½ E - 6 S			
27+30	1149.39	Top Stk - E^{s} lane			
60+65	1145.27	Nail Tel p S^{s} of ditch E^{s} of Rd			
90+00	1139.52	Top 4x4" post - S^{s} of ditch			
92+50	1137.95	Nail - Tel p - S^{s} of ditch			
134+00	1134.73	Top Stk - S^{s} of ditch			
149+75	1129.61	Nail pwrp - N^{s} of ditch			

0+75		12" Steel gas p			
0+58		12" Steel gas p			
0+25		X-Sec			
0+00		Fence E & W 20½ E - 65			



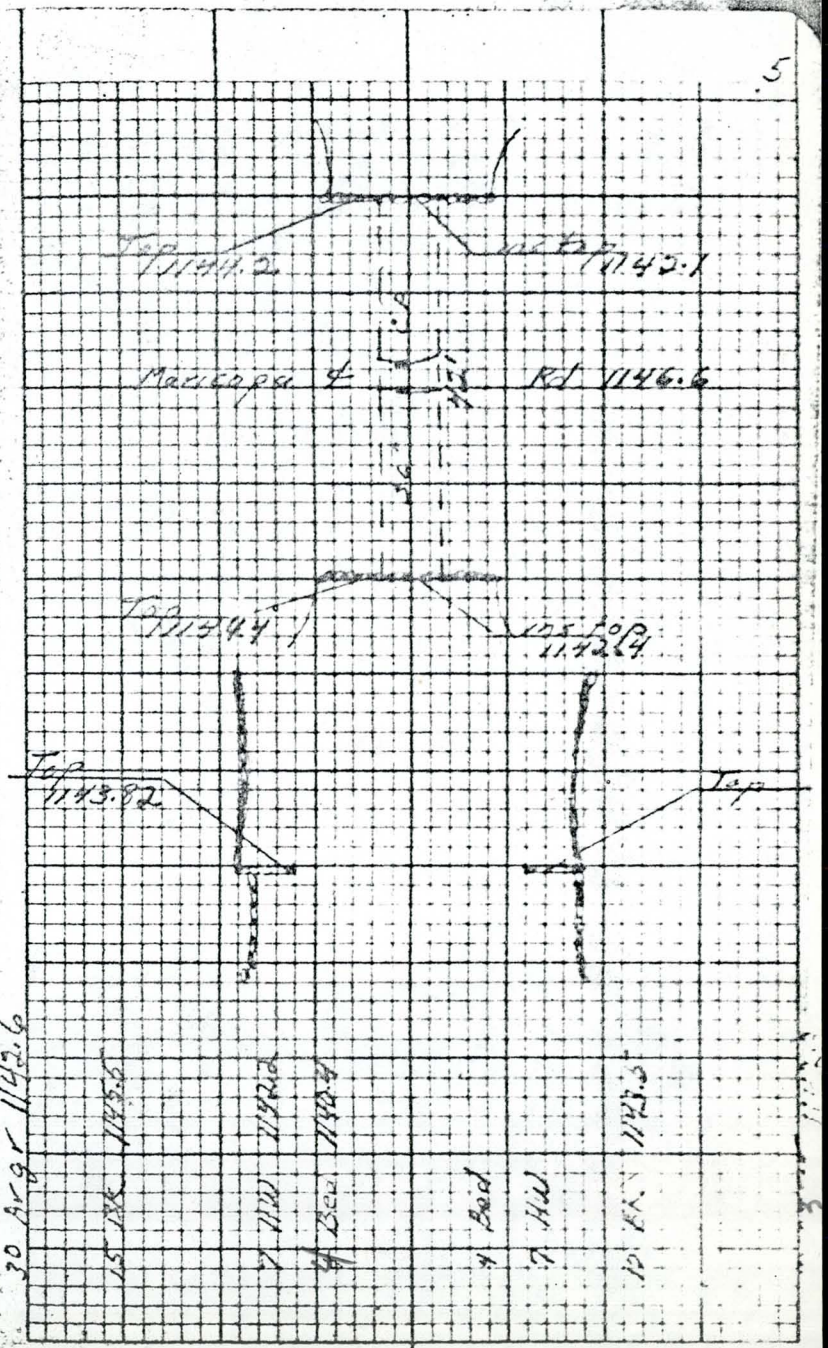
44+75 X-Sec

43+60 Natural drop-2'?

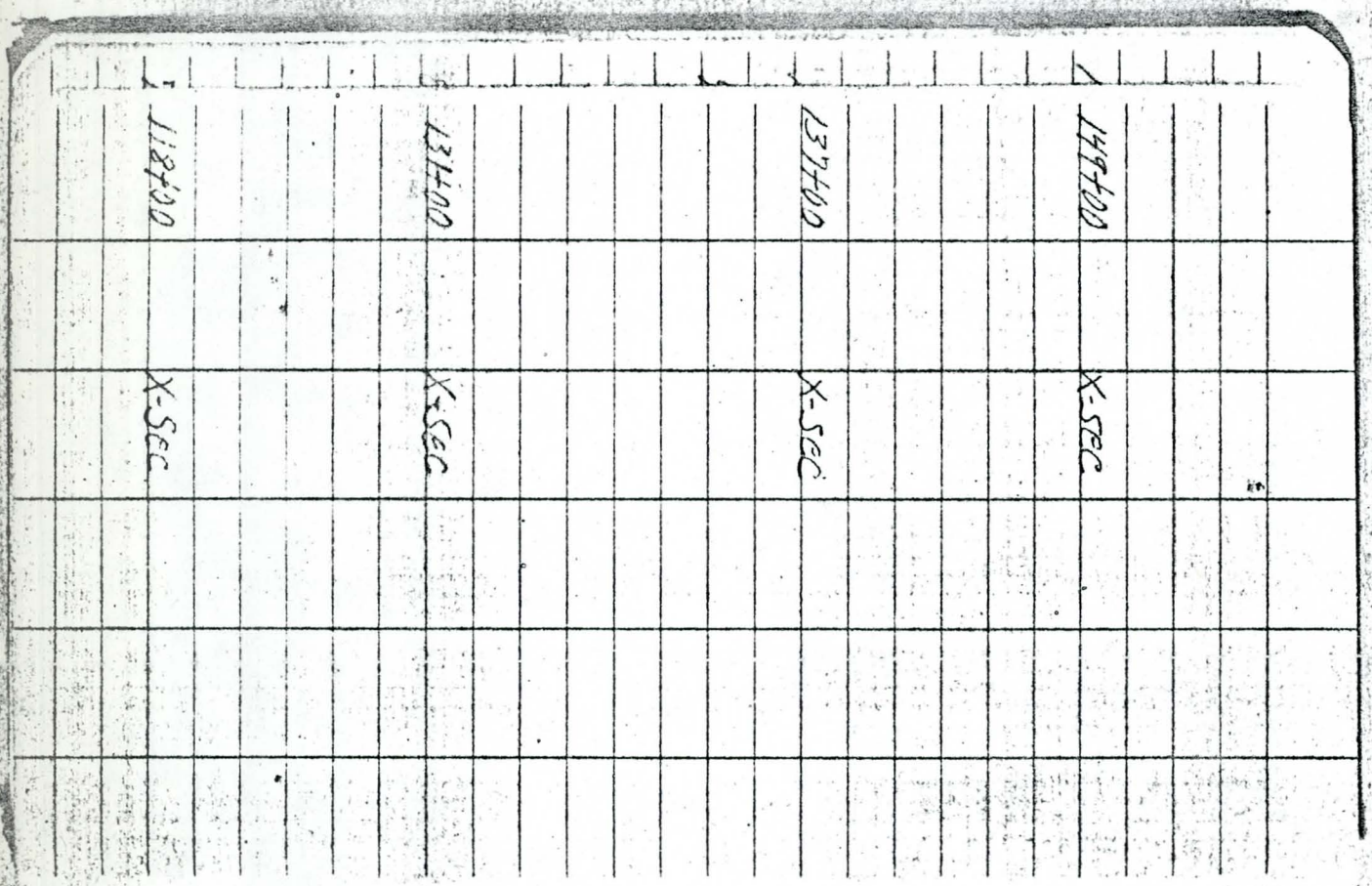
24+00 X-Sec

13+20 X-Sec

60+90		F E 36" CP			
60+25		Hold			
57+50		X-sec Ditch turns		SW	



107+00		X-Sec			
93+00		X-Sec			
92+50		Tel line N&S			
80+00		X-Sec			
72+00		X-Sec			



40	Avgr	1133.2	40	Avgr	1133.8	40	Avgr	1128.8	40	Avgr	1128.5				
12	BK	1134.5	14	BK	1134.6	13	BK	1133.2	12	BK	1130.1				
8	HW	1132.2	6	HW	1133.6	7	HW	1130.6	7	HW	1127.9				
4	Bed	1130.5	4	Bed	1129.0	5	Bed	1127.8	5	Bed	1126.2				
4	Bed		4	Bed		5	Bed		5	Bed					
8	HW		6	HW		7	HW		7	HW					
12	BK	1134.7	14	BK	1134.7	13	BK	1131.8	11	BK	1127.8				
40	Avgr	1133.1	40	Avgr	1132.7	40	Avgr	1130.8	40	Avgr	1128.9				

Continue on pg 41

151+00	X-Sec
149+75	℄ Pwr line N&S No banks on ditch Floods wide Area

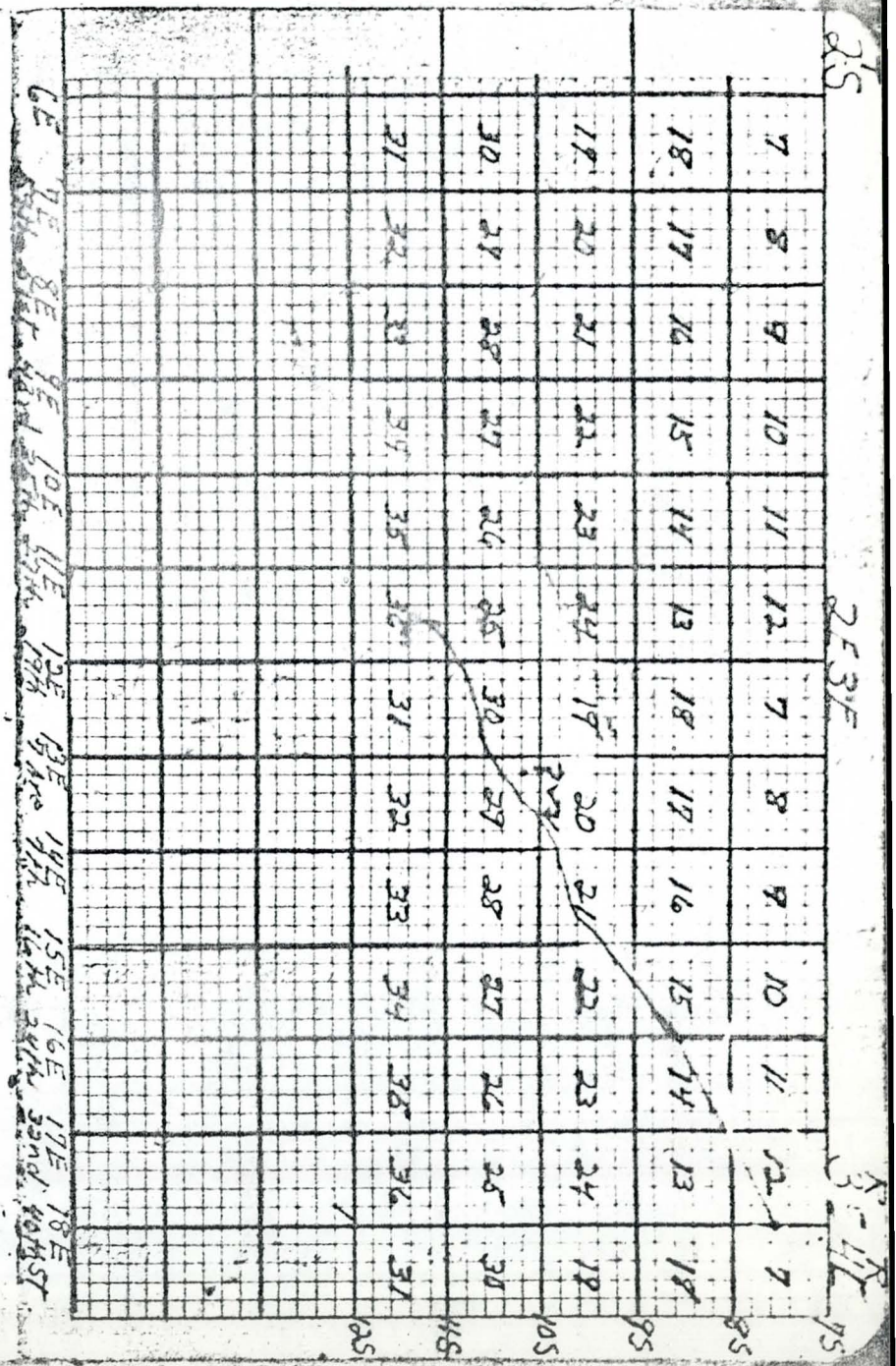
40 Avg 1128.3
7 BK 1135.1
5 H2O
3 Bed
3 Bed 1127.9
5 H2O 1128.9
7 BK 1130.2
42 Avg 1128.7

Start of Profile pg 1

Continued Profile of
Tempe Drain to Gila River

WO-B7-0025-662-079

PLOTTED BY R.G. CRAFTS
12-21-66



Power Line	N&S	Sec 7 / Sec 12 - 1911
150+35	1129.38	BC - S of ditch 450' +
154+00	1131.34	Top Stk.
160+00	1130.09	" "
164+35	1128.46	BC. - S of ditch 500' +
166+00	1128.79	Top Stk
172+00	1128.01	" "
178+00	1127.49	" "
184+00	1128.14	" "
190+00	1127.23	" "
196+00	1124.38	" "
202+00	1122.71	" "
208+00	1121.81	" "
214+00	1120.48	" "
220+00	1121.44	" "
226+00	1122.69	" "
232+00	1119.93	" "
238+00	1116.46	" "
244+00	1115.43	" "
250+00	1113.29	" "
256+00	1111.54	" "
262+00	1109.29	" "
268+00	1109.35	" "
274+00	1107.17	" "
280+00	1108.10	" "
286+00	1106.83	" "
292+00	1107.00	" "

298+00	Top of Stake T.P.	1104.67
302+00	" " Nail " "	1103.76
304+00	Top of Stake	1101.44
310+00	" " "	1105.16
316+00	" " "	1103.76
[illegible]	" " "	1108.97
328+00	" " "	1105.45
334+00	" " "	1104.08
340+00	" " "	1104.27
346+00	" " "	1105.39
352+00	" " "	1100.99
358+00	" " "	1098.78
[illegible]	" " "	1098.58
[illegible]	" " "	1097.03
[illegible]	" " "	1098.13
376+00	" " "	1100.16
382+00	" " "	1098.71
388+00	" " "	1094.92
394+00	" " "	1095.89
400+00	" " "	1096.16
406+00	" " "	1093.03
412+00	" " "	1093.62
418+00	" " "	1096.20
424+00	" " "	1094.37
436+00	" " "	1094.98
442+00	" " "	1092.28
448+00	" " "	1094.33
454+00	" " "	1096.30
460+00	" " "	1095.91
T.P.	" " "	1090.19
472+00	" " "	1089.94
478+00	" " "	1089.77
484+00	" " "	1092.25

Cont Pg 78

186+50	1124.0	Bed of wash from S	
	1123.0	Bed of wash from N	
183+45		X-Sec	35 Ar Gr 1124.5
177+50		X-Sec	35 Ar Gr 1126.7
158+80	1126.3	Bed of wash from S	
151+00		X-Sec pg 8	

203+17		X-Sec			
200+40	1118.9	Bed of wash from N			
200+25	1119.1	Bed of wash from S			
187+25	1122.6	Bed of wash from N			
186+80		X-Sec			

40 Avg = 1120.2

35 Avg = 1125.6

15 BK 1121.7

10 BW 1118.5

5 Bed 1117.0

10 BW 1121.6

5 BK 1125.3

1 BK 1126.6

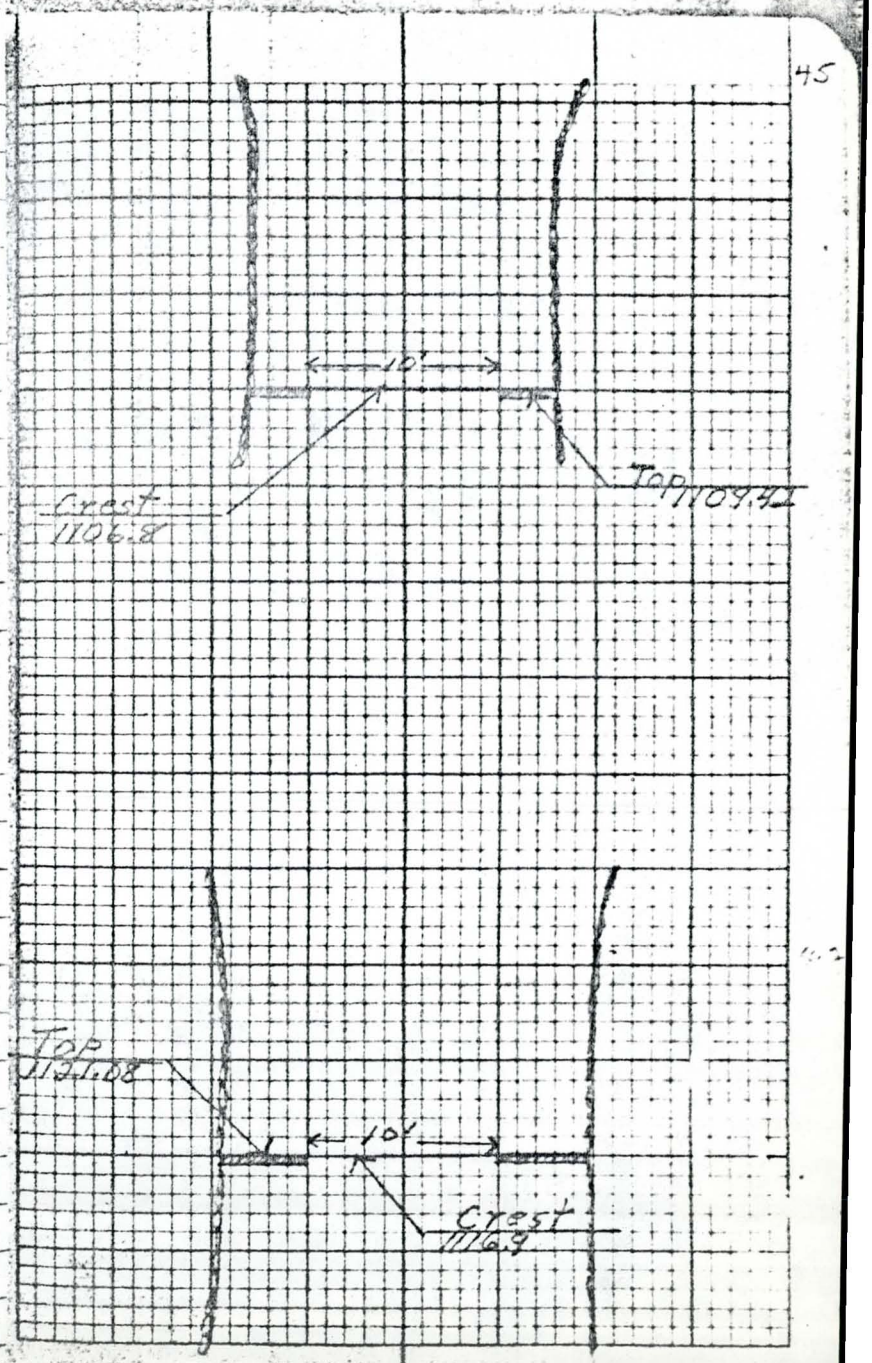
1 Bed 1122.3

3 BW 1124.1

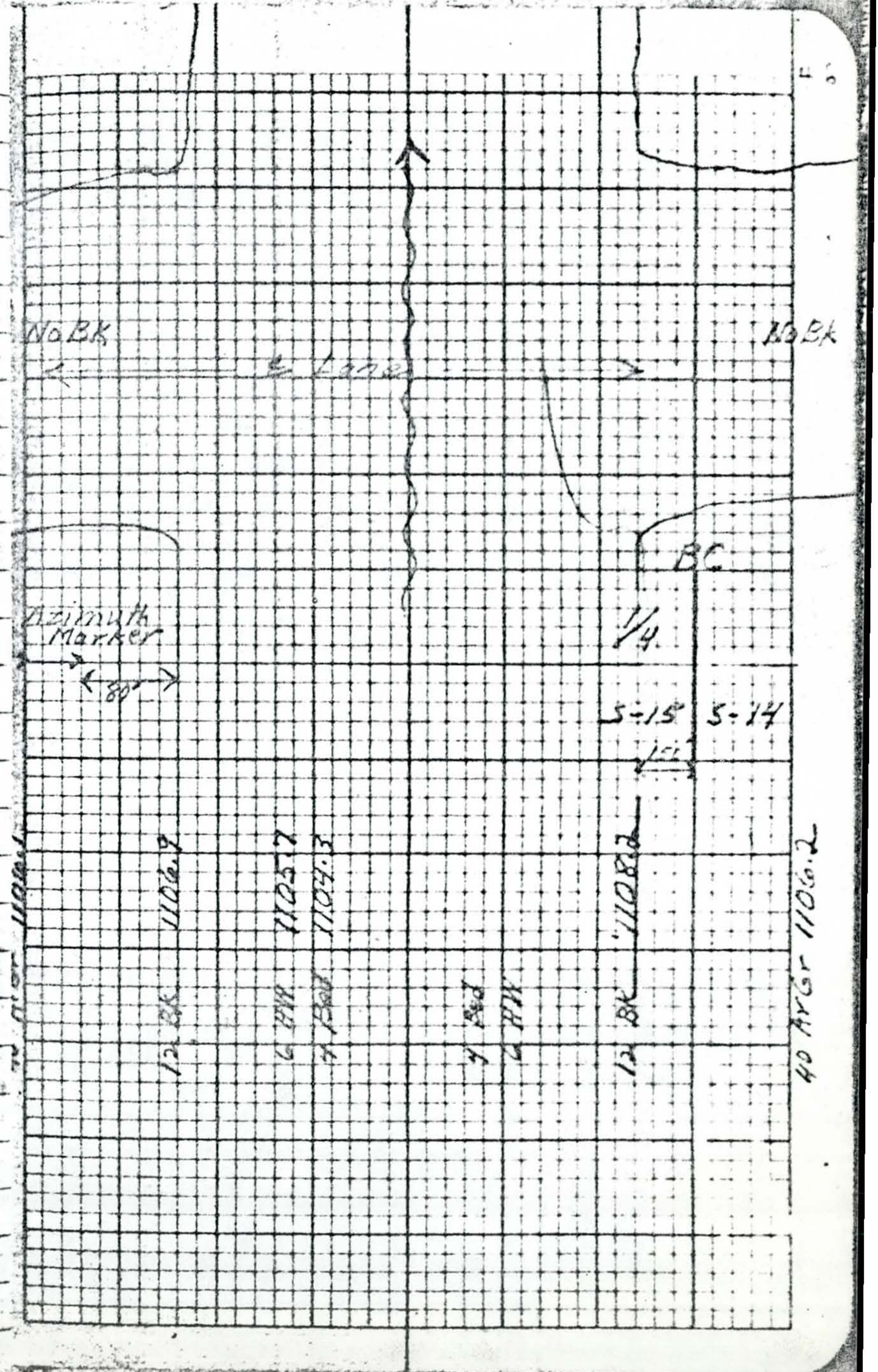
40 Avg = 1120.3

1 BK 1124.6

259+45		+ Top - N^{s} ck	
249+00	1113.40	Nail in Stump 60' South of ditch	
226+00	1117.64	Top ½" iron p. 50's of ditch - S W cor	
205+90	1121.08	+ Top - S^{s} ck	



274+15	1104.6	℄ of Lane - Bed
		Bks are out
		BC 150'± N of ditch
Top	1106.78	BC 80'± S of ditch is
		Azimuth Makk to N
273+85		X-Sec
273+65		BC-150'± N of ditch
273+65		BC-80'± S of ditch
262+25±	1106.3	Bed of Wash from S



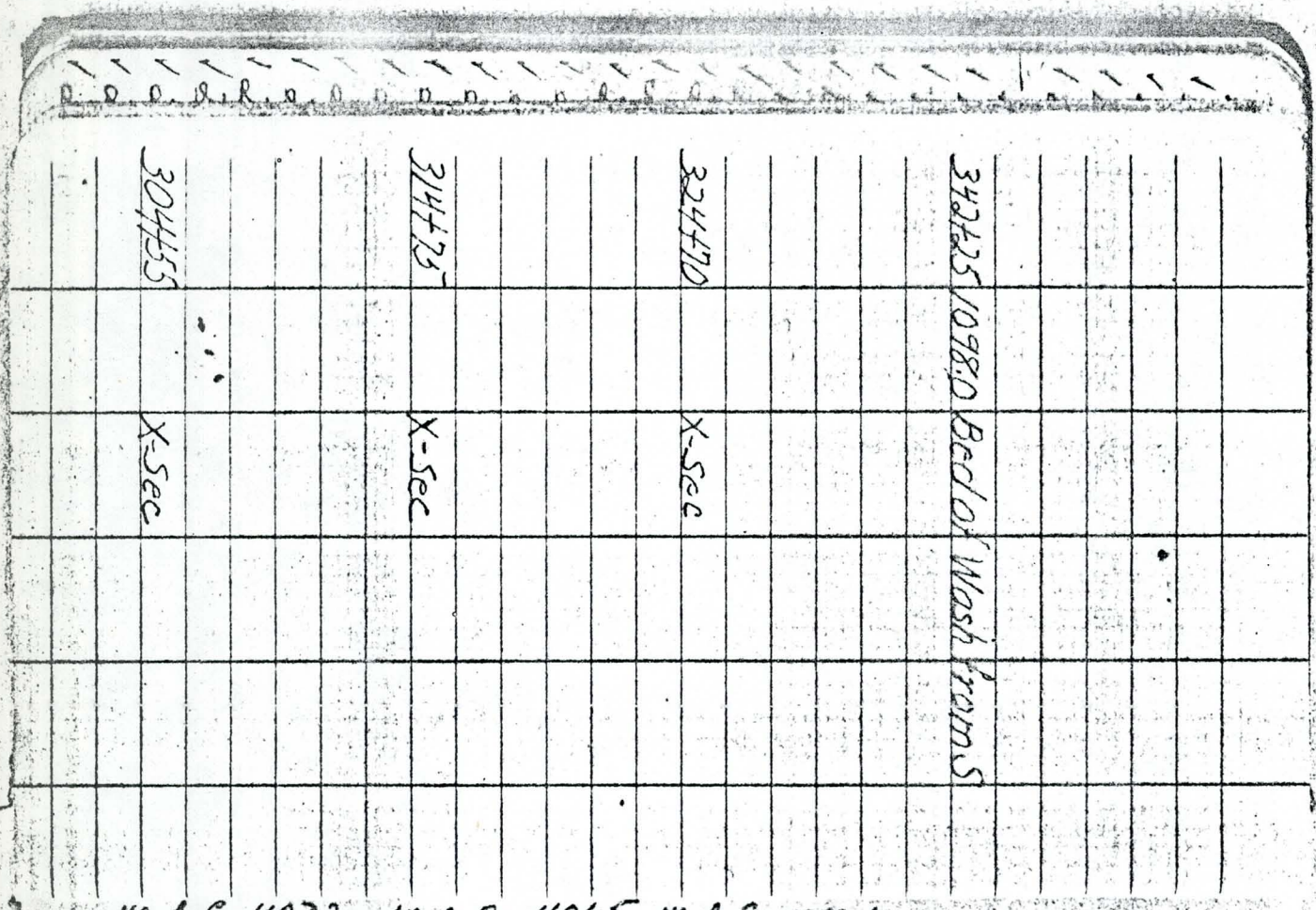
303+90	1102.6	Bed of Wash from S			
298+25	1102.5	Bed of Wash from S			
297+09	1102.5	Bed of Wash from S			
296+25		X-Sec			
296+11	1101.0	Bed of Wash from S			
294+50	1101.6	Bed of Wash from S			
291.10	1102.1	Bed of Wash from S			
289.85	1102.6	Bed of Wash from S			
284+30	1103.2	Bed of Wash from S			

12 BK 1104.1
2 HW 1103.5
4 Bed

4 Bed 1101.0
2 HW

12 BK 1103.3

40 Arch 1103.2



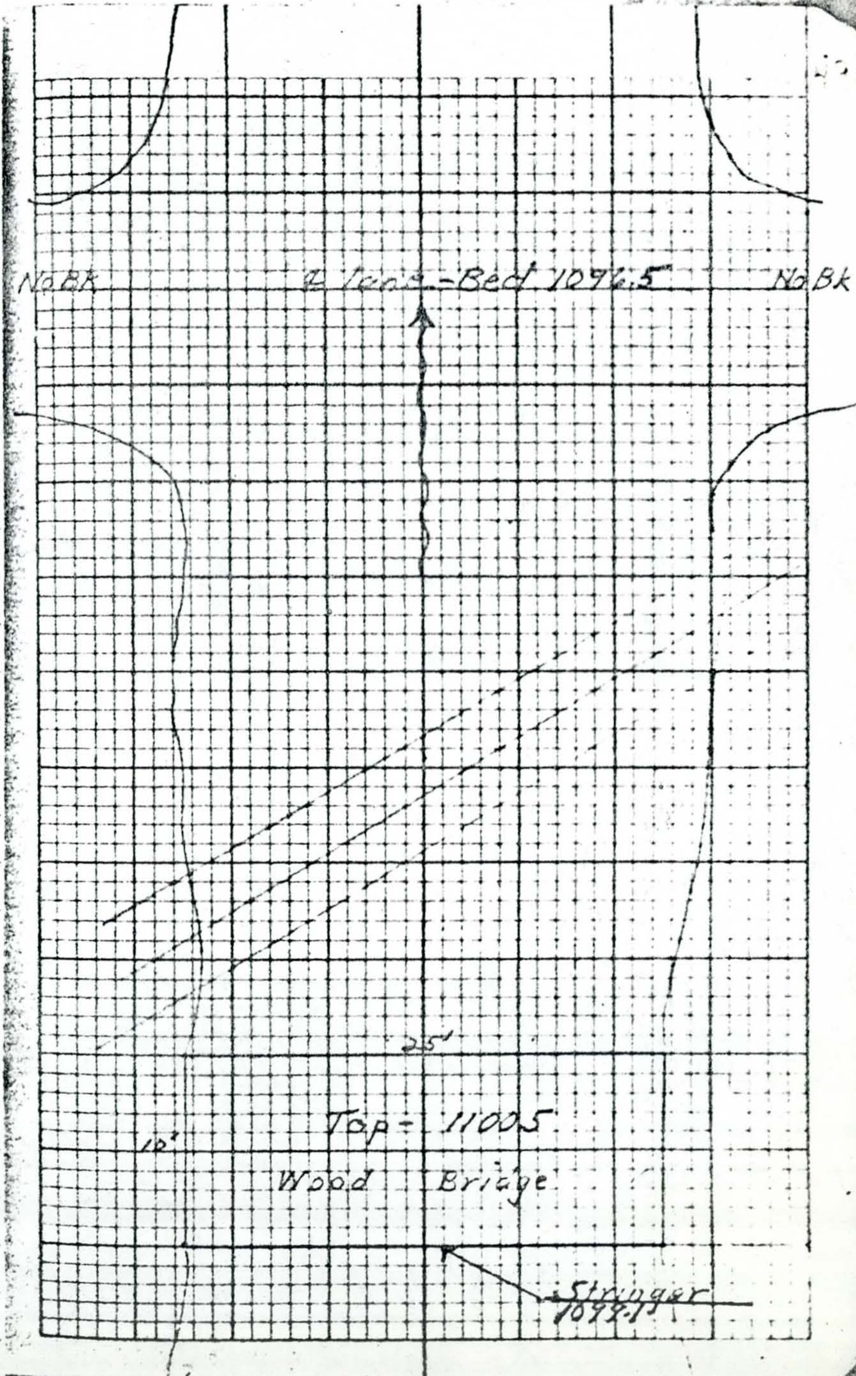
40 AvGr 1103.2 40 AvGr 1101.5 40 AvGr 1102.1

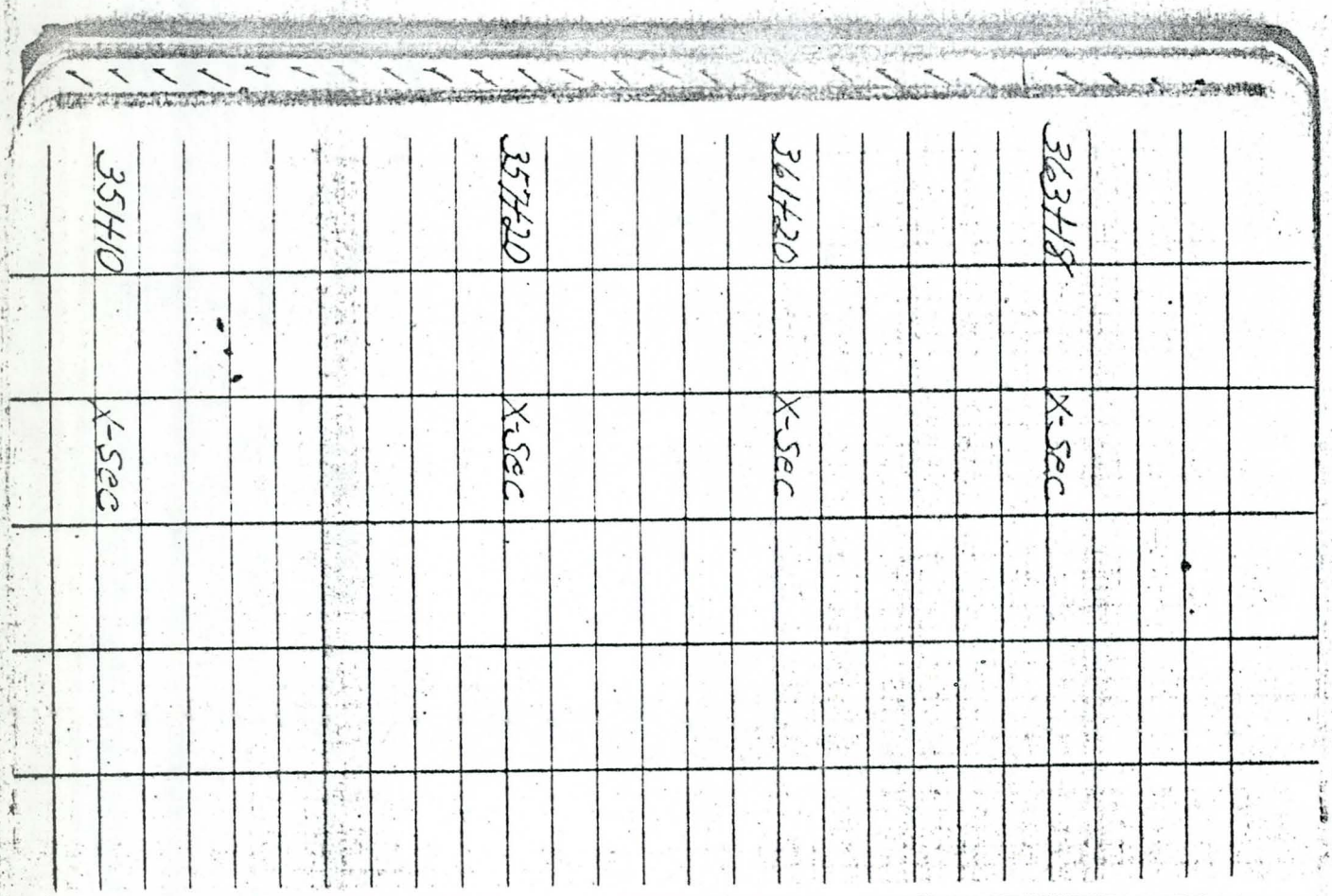
15 BK 1107.5
12 BK 1102.5
8 HW
7 HW
5 Bed
3 Bed
3 Bed 1101.2
5 Bed 1100.2
7 HW 1102.5
8 HW 1101.4
12 BK 1103.1
16 BK 1107.2

15 BK 1107.1
8 HW 1101.0
5 Bed 1099.1
5 Bed
8 HW
15 BK 1102.4

40 AvGr 1105.6 40 AvGr 1101.5 40 AvGr 1101.6

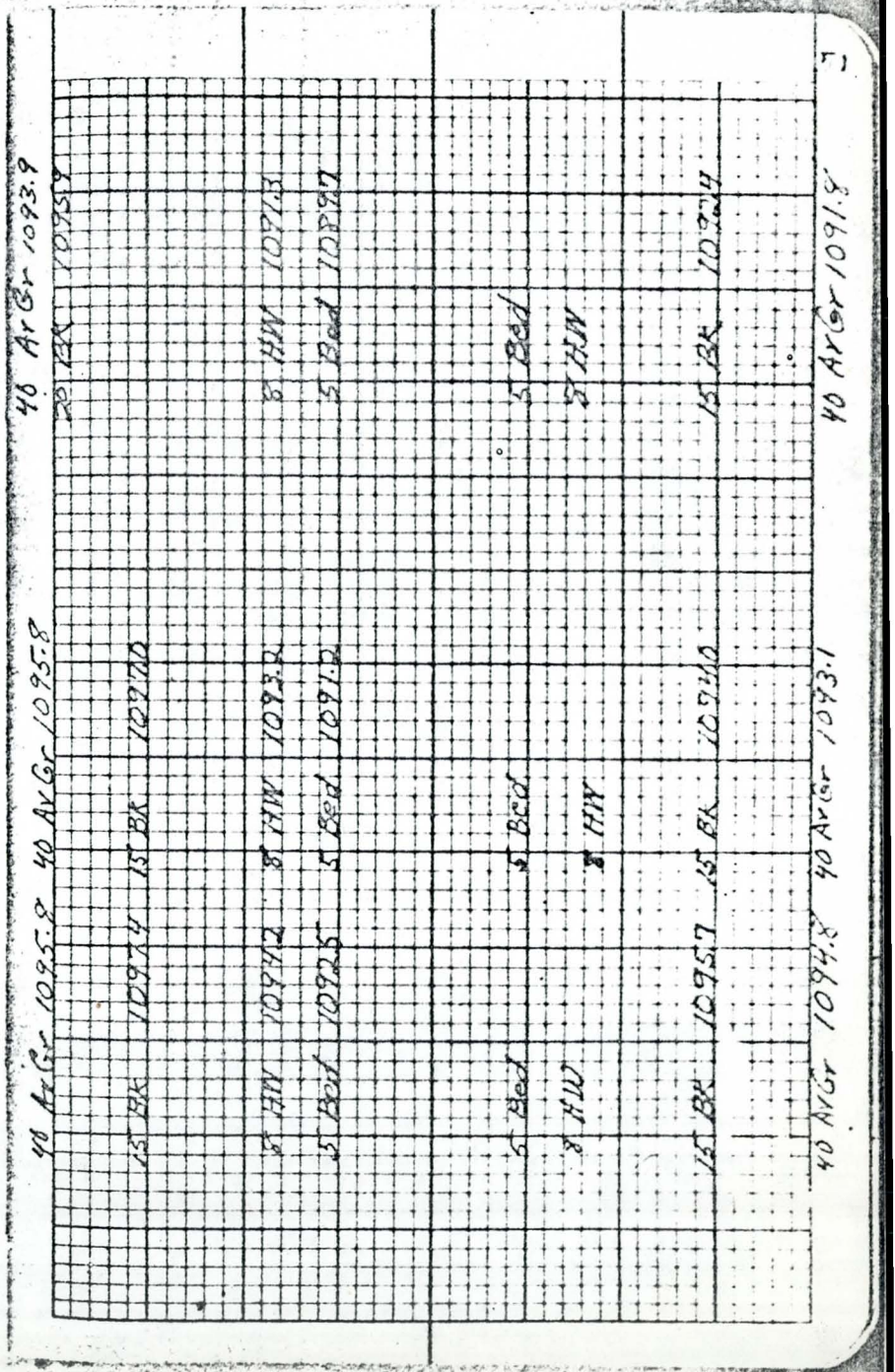
347+90		℄ of Lane
345+75		Pwr Line Crosses ditch
345+55	1102.41	Nail S^S Pwr P - S^S of ditch
345+40	-	Wood bridge





40 AvGr 1097.8
20 BK 1099.2
11 HW 1096.2
3 Bed 1093.7
5 Bed
11 HW
15 BK 1093.2
40 AvGr 1099.8
20 BK 1100.3
7 HW
3 Bed 1094.6
3 Bed
7 HW 1096.0
15 BK 1097.5
40 AvGr 1098.3
15 BK 1097.2
8 HW
4
4 Bed 1094.3
8 HW 1096.4
30 BK 1097.4
40 AvGr 1096.7
15 BK 1096.2
8 HW 1094.9
5 Bed 1093.2
5 Bed
8 HW
15 BK 1095.9
40 AvGr 1097.7
40 AvGr 1095.7
40 AvGr 1097.1
40 AvGr 1095.8

397+30		X-Sec			
388+10	1090.1	Bed of Wash from N			
382+60		X-Sec			
369+36		X-Sec			
364+34	1094.2	Bed of Wash from S			



408+87 1094.57 X-Sec - Top of Stk

407+26 X-Sec

406+70 1089.3 Bed of Wash from S

399+15 X-Sec

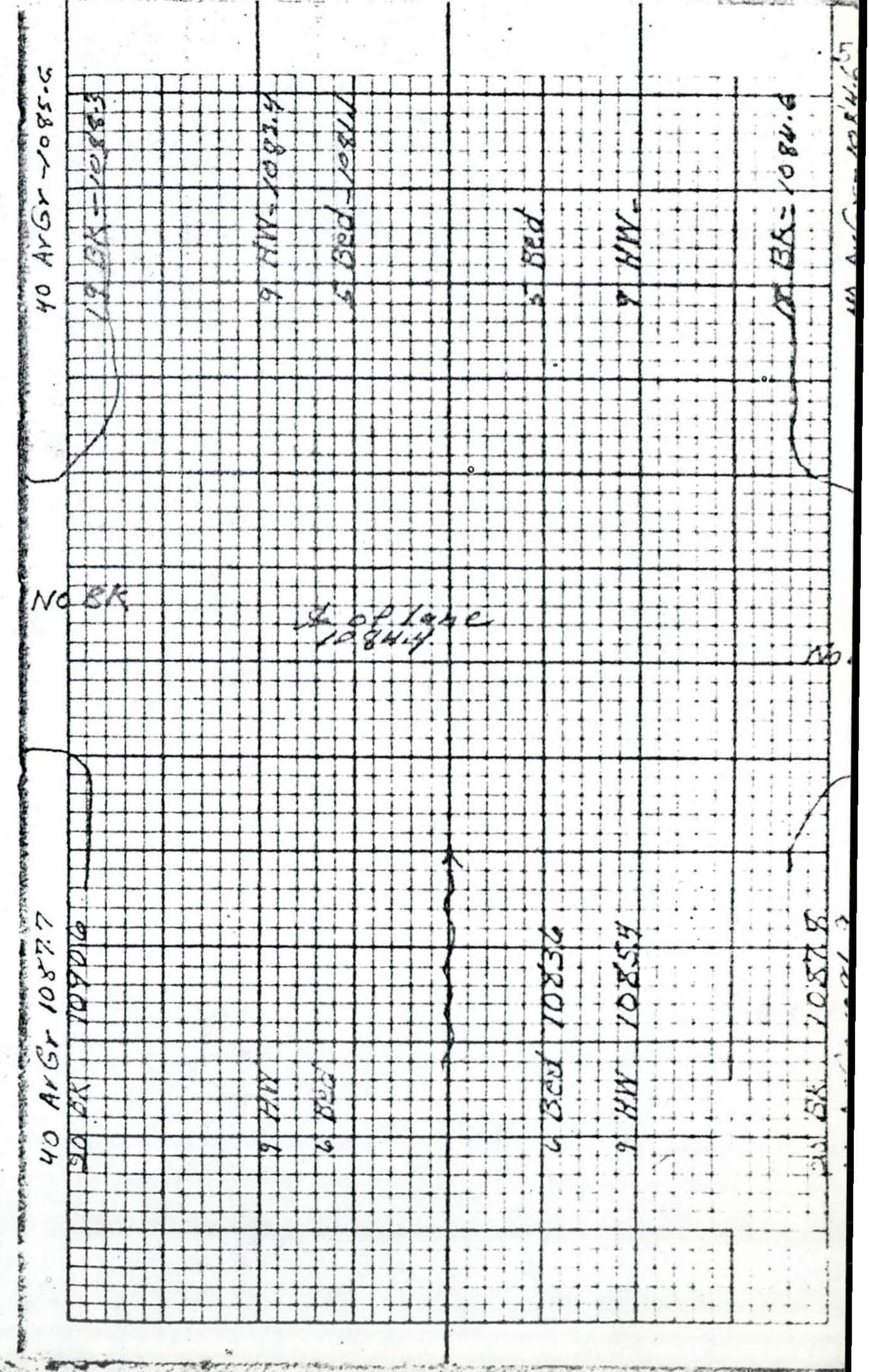
40 ArGr 1093.4
30 BK 1092.0
7 HW
5 Bed
5 Bed 1087.1
7 HW 1090.8
15 BK 1093.3
40 ArGr 1091.7

40 ArGr 1091.1
30 BK 1090.9
7 HW 1089.8
5 Bed 1088.9
5 Bed
7 HW
15 BK 1091.3
40 ArGr 1091.1

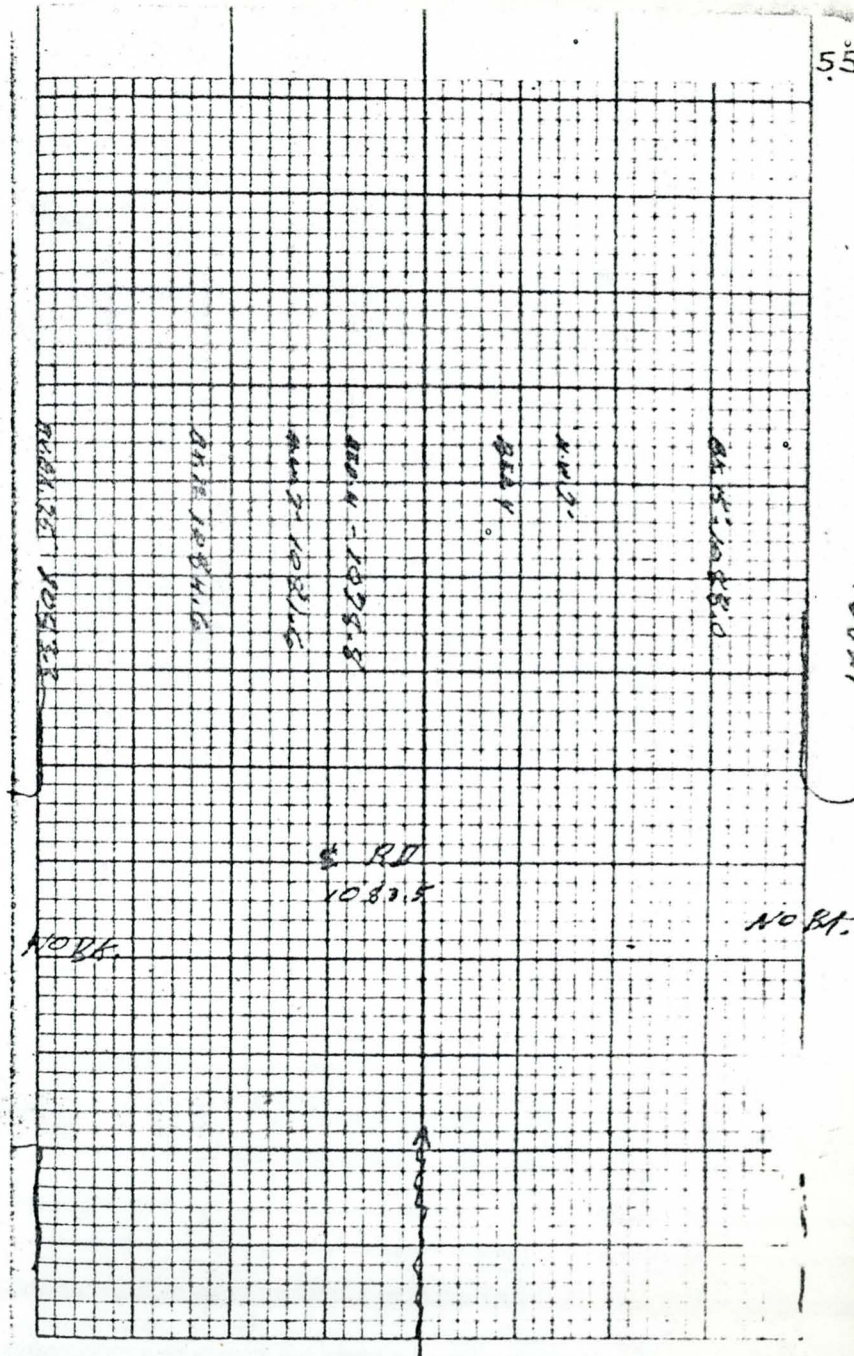
40 ArGr 1092.3
15 BK 1092.9
7 HW 1089.0
5 Bed 1088.5
5 Bed
7 HW
15 BK 1093.0
40 ArGr

456+90		X-Sec			
448+40		X-Sec			
442+25		X-Sec			
439+88	1090.5	Bed of Wash from S			
435+50	1087.6	Bed of Wash from S			
428+90	1087.7	Bed of Wash from S			

501+00	X-Sec				
499+88	℄ of lane - Ditch filled in				
480+50	X-Sec				



544+20	1078.1 E	BED WASH S. BK.
538+35		X SEC.
532+00		CHANGE TO N.S. DITCH
		TO MAKE ROAD
522+40		℄ RD. DITCH PUSHED IN



1079.2 BED

557+78 & WASH FROM N

1079.4 BED

557+09 & WASH FROM N

1079.6 BED

557+78 & WASH FROM N.

555+66 & RR.

N.

553+57 1079.4 & WASH BED FROM

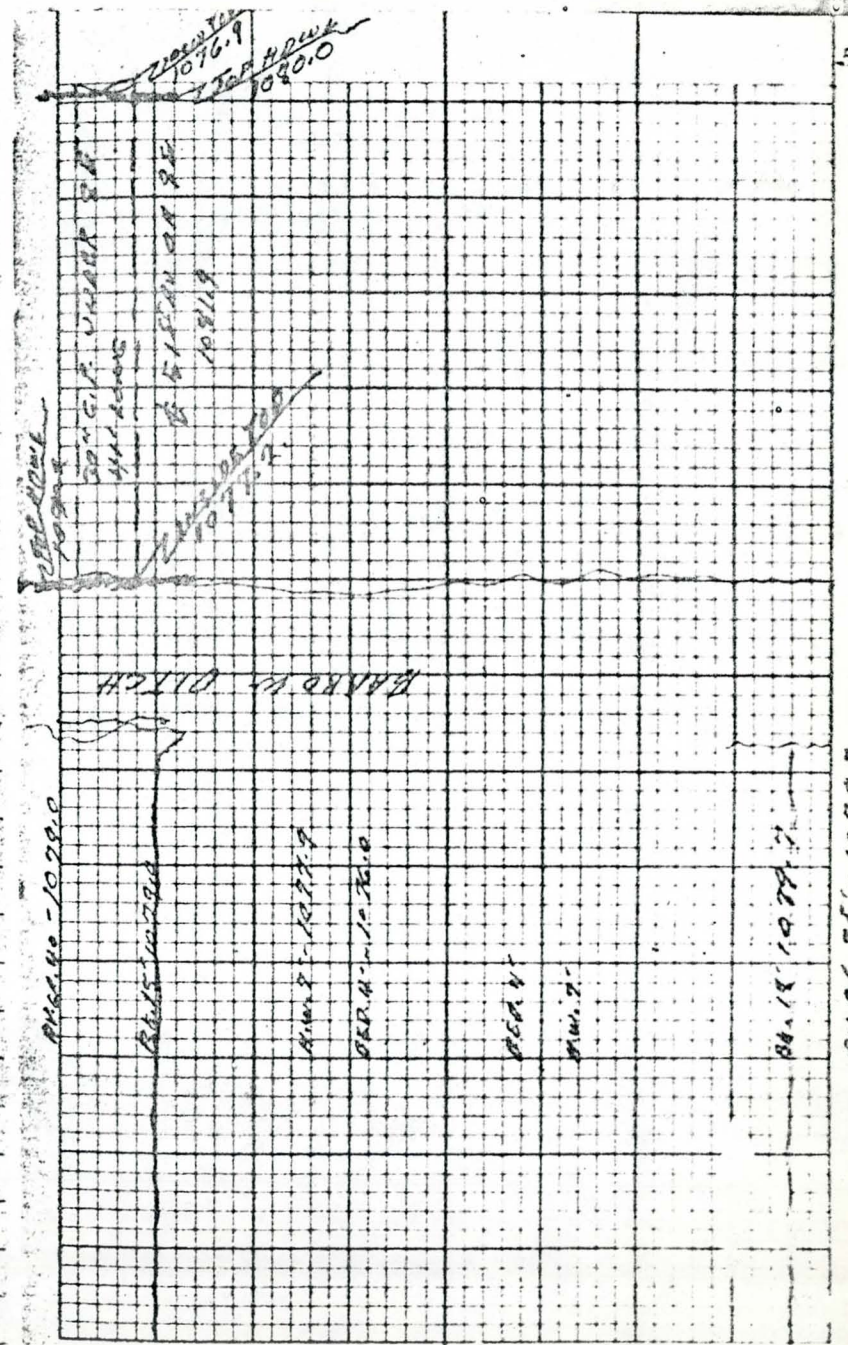
NO BR

& RD.

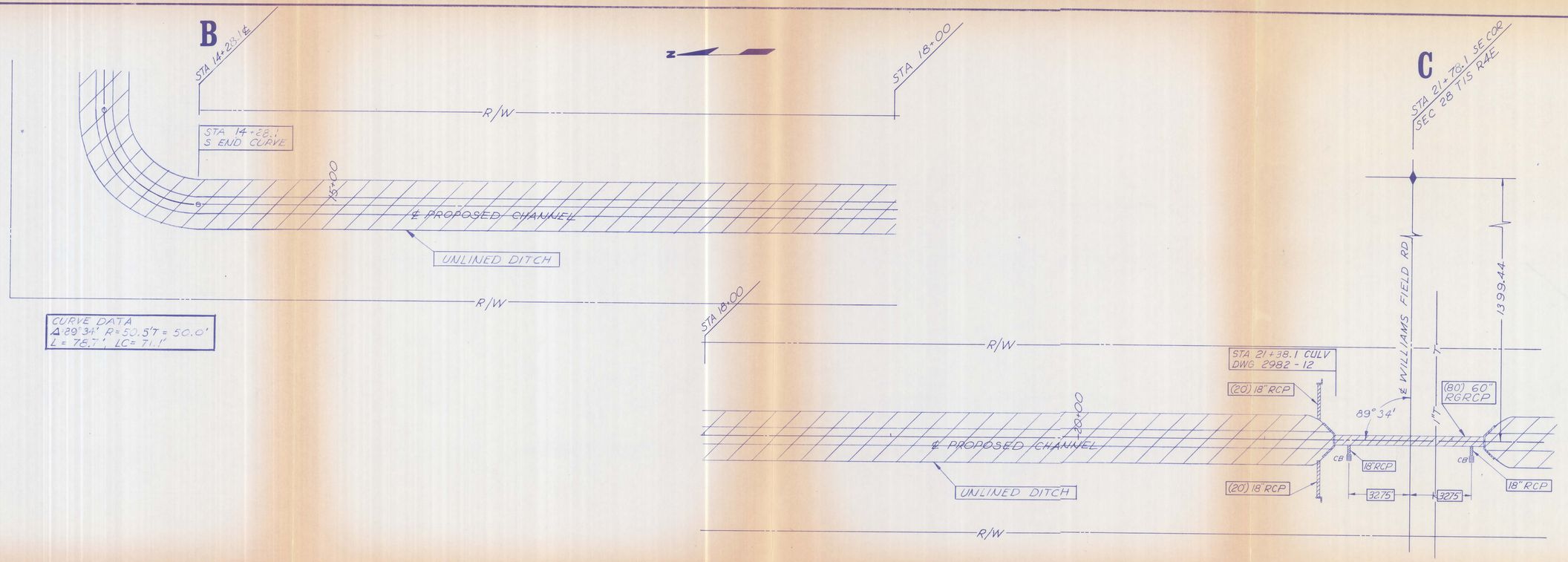
1080.2

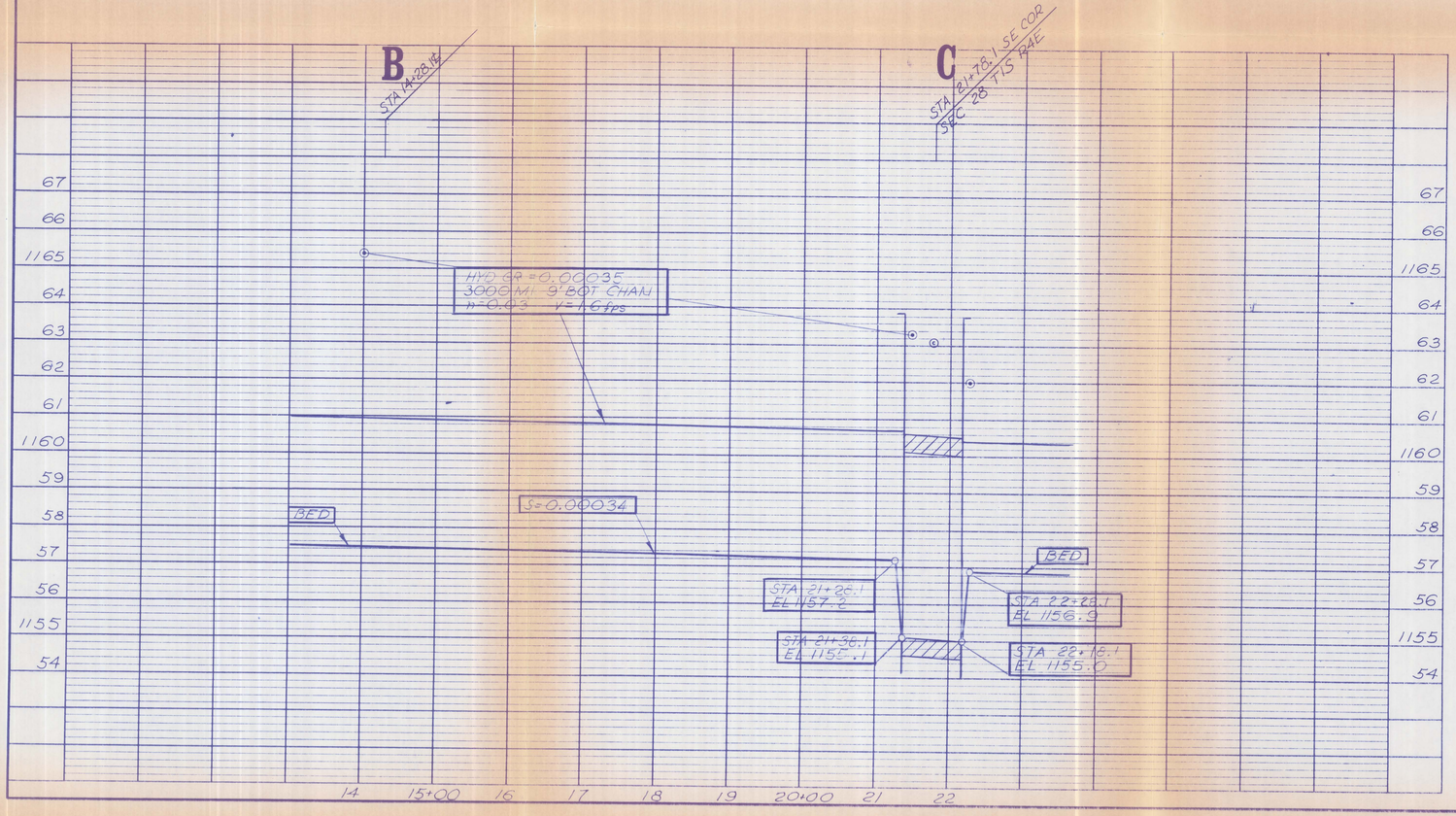
NO B

581+11	W^{E} 30" C.P. UNDER SE OR 51ST AV.	
	NOTE PIPE FULL OF SAND & DIRT	
580+70	E^{E} 30" C.P. UNDER SE.	
580+00	X SEC	
	WEST UNDER 51ST AV. OR SE	
	SOUTH 150' DEN GOES	
	INTO BORROW DITCH GOES	
580+50	GILA RIVER DRAIN DUMPS	



604+70		SE of drain ditch
603+62	1065.8	Bed of Wash from E
603+50		X-Sec
600+30	1066.7	Bed of Wash from E





TBM:
NAIL N SIDE TRIPLE TRANS POLE SW COR INTER 21E-5S
EL 1167.09

CONSTRUCTION LEGEND
CONSTRUCTION BY S R V W U A
CONSTRUCTION BY PERMITTEE

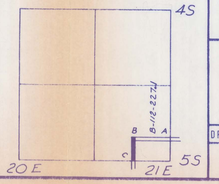
NOTE:
THE ASSOCIATION DOES NOT GUARANTEE THE LOCATION OR ELEVATION OF UTILITIES AND WILL NOT BE RESPONSIBLE FOR THEIR RELOCATION UNLESS OTHERWISE STATED

ALL CONSTRUCTION BY PERMITTEE EXCEPT CULV DWG #2982-12 BY MCHD

FOR TYPICAL CROSS SECTION OF DITCH SEE DWG #B-112-226

SYMBOLS FOR PROFILE
- CENTER LINE OF ROAD
- LOW BANK
- BED
- AVERAGE GROUND LEFT
- AVERAGE GROUND RIGHT
- AVERAGE GROUND (ONE GIVEN)
- HIGH WATER
- CENTER LINE PVT SLIPFORM
- HI GROUND
- LOW GROUND

PLOTTED FROM WUA FIELD NOTES

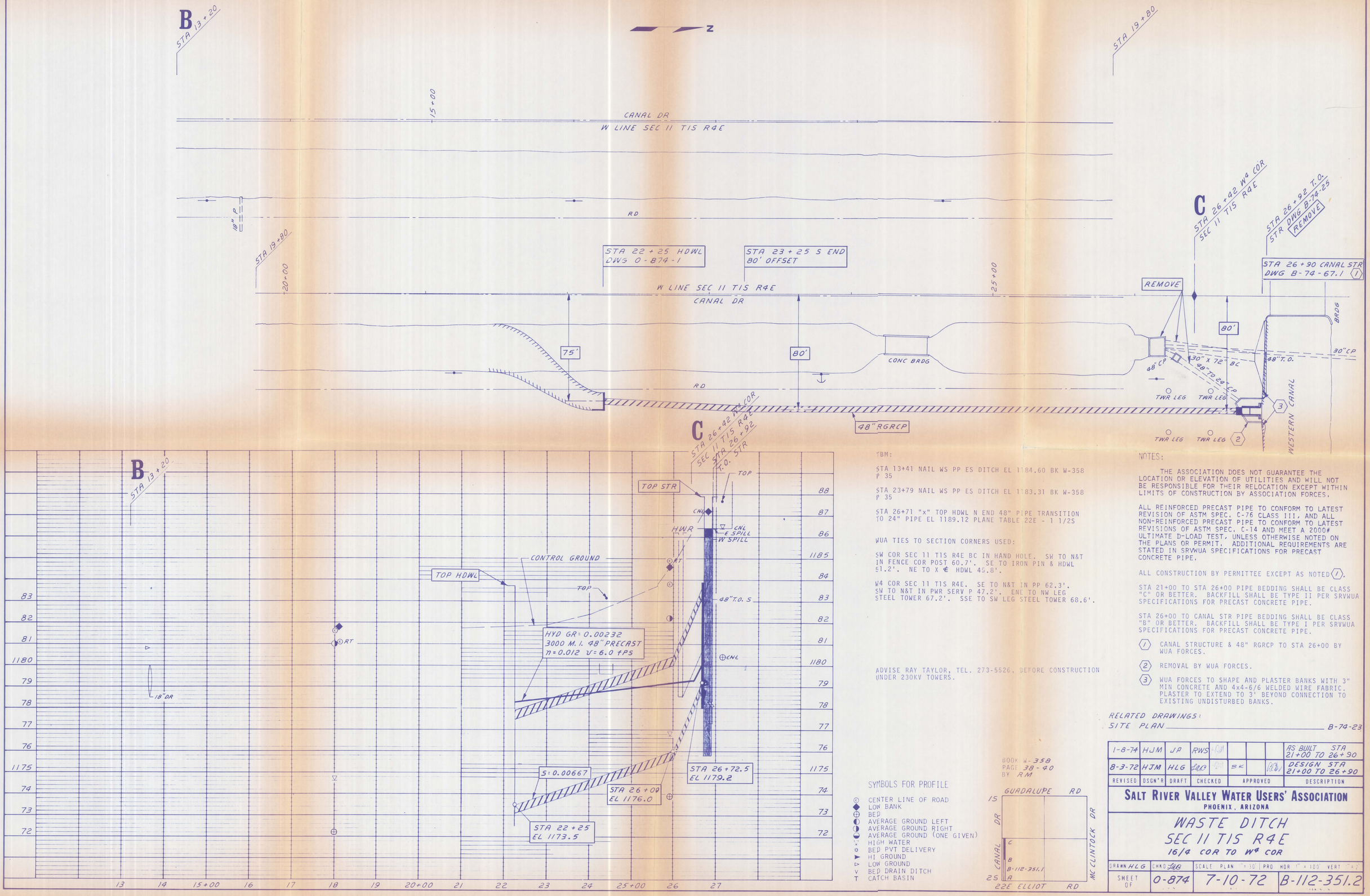


REVISED	BY	CHECKED	APPROVED	DESCRIPTION
7-14-69	JM M	AR	RWS	AS-BUILT
4-7-67	SVB	AR	FAB	DESIGN

SALT RIVER VALLEY WATER USERS' ASSOCIATION
PHOENIX, ARIZONA

TEMPE-GILA WASTE DITCH
SEC 28 T1S R4E
800' N 16/16 COR TO 16/16 COR

DRAWN: SVB	CHKD: ABG	SCALE: PLAN 1" = 30'	PRO HOR 1" = 100' VERT 1" = 2'
SHEET 3 OF 4	6-155 JOB NO.	3-23-67 DATE	B-112-227.2 DRAWING NO.



TBM:

STA 13+41 NAIL WS PP ES DITCH EL 1184.60 BK W-358 P 35

STA 23+79 NAIL WS PP ES DITCH EL 1183.31 BK W-358 P 35

STA 26+71 "x" TOP HDWL N END 48" PIPE TRANSITION TO 24" PIPE EL 1189.12 PLANE TABLE 22E - 1 1/2S

WUA TIES TO SECTION CORNERS USED:

SW COR SEC 11 T1S R4E BC IN HAND HOLE. SW TO N&T IN FENCE COR POST 60.7'. SE TO IRON PIN & HDWL 61.2'. NE TO X ∉ HDWL 45.8'.

W4 COR SEC 11 T1S R4E. SE TO N&T IN PP 62.3'. SW TO N&T IN PWR SERV P 47.2'. ENE TO NW LEG STEEL TOWER 67.2'. SSE TO SW LEG STEEL TOWER 68.6'.

ADVISE RAY TAYLOR, TEL. 273-5526, BEFORE CONSTRUCTION UNDER 230KV TOWERS.

NOTES:

THE ASSOCIATION DOES NOT GUARANTEE THE LOCATION OR ELEVATION OF UTILITIES AND WILL NOT BE RESPONSIBLE FOR THEIR RELOCATION EXCEPT WITHIN LIMITS OF CONSTRUCTION BY ASSOCIATION FORCES.

ALL REINFORCED PRECAST PIPE TO CONFORM TO LATEST REVISION OF ASTM SPEC. C-76 CLASS III, AND ALL NON-REINFORCED PRECAST PIPE TO CONFORM TO LATEST REVISIONS OF ASTM SPEC. C-14 AND MEET A 2000# ULTIMATE D-LOAD TEST, UNLESS OTHERWISE NOTED ON THE PLANS OR PERMIT. ADDITIONAL REQUIREMENTS ARE STATED IN SRVWUA SPECIFICATIONS FOR PRECAST CONCRETE PIPE.

ALL CONSTRUCTION BY PERMITTEE EXCEPT AS NOTED (1).

STA 21+00 TO STA 26+00 PIPE BEDDING SHALL BE CLASS "C" OR BETTER. BACKFILL SHALL BE TYPE II PER SRVWUA SPECIFICATIONS FOR PRECAST CONCRETE PIPE.

STA 26+00 TO CANAL STR PIPE BEDDING SHALL BE CLASS "B" OR BETTER. BACKFILL SHALL BE TYPE I PER SRVWUA SPECIFICATIONS FOR PRECAST CONCRETE PIPE.

(1) CANAL STRUCTURE & 48" RGRCP TO STA 26+00 BY WUA FORCES.

(2) REMOVAL BY WUA FORCES.

(3) WUA FORCES TO SHAPE AND PLASTER BANKS WITH 3" MIN CONCRETE AND 4x4-6/6 WELDED WIRE FABRIC. PLASTER TO EXTEND TO 3' BEYOND CONNECTION TO EXISTING UNDISTURBED BANKS.

RELATED DRAWINGS:
SITE PLAN — B-74-23

BOOK W-358
PAGE 38-40
BY RM

SYMBOLS FOR PROFILE

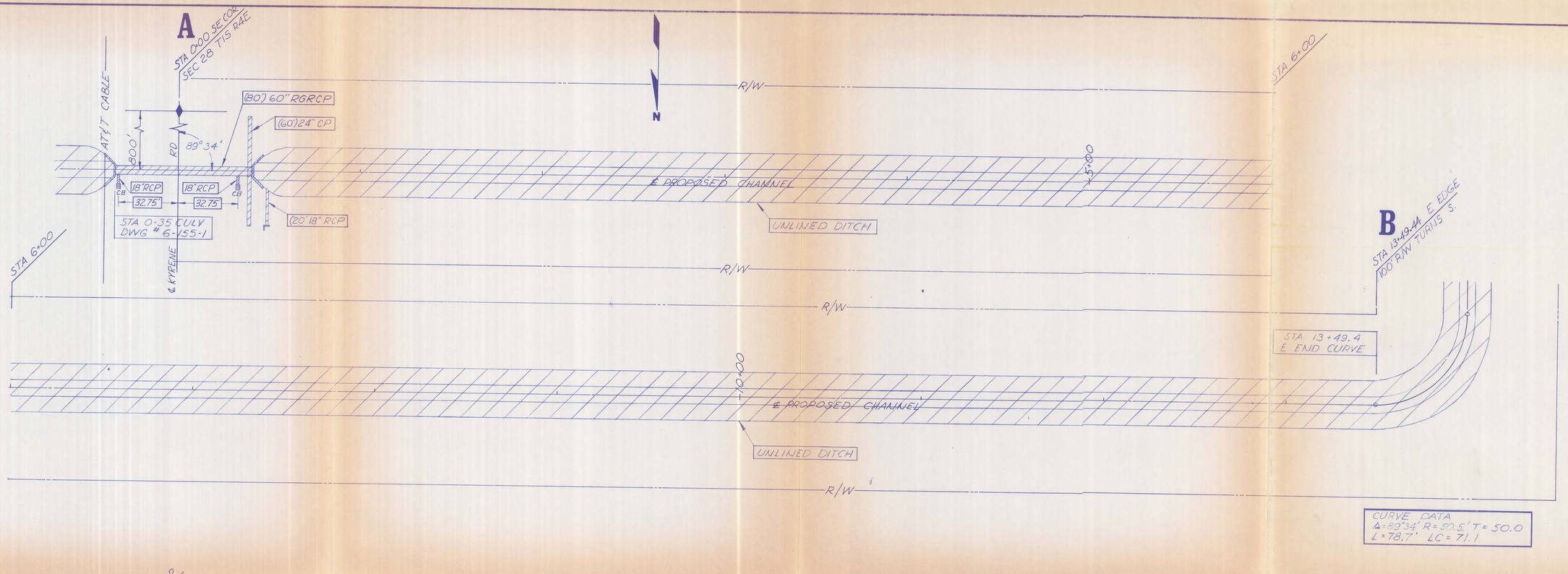
- ℄ CENTER LINE OF ROAD
- ◆ LOW BANK
- ⊕ BED
- ◐ AVERAGE GROUND LEFT
- ◑ AVERAGE GROUND RIGHT
- ◒ AVERAGE GROUND (ONE GIVEN)
- ▽ HIGH WATER
- ○ BED PVT DELIVERY
- ▶ HI GROUND
- ▽ LOW GROUND
- V BED DRAIN DITCH
- T CATCH BASIN

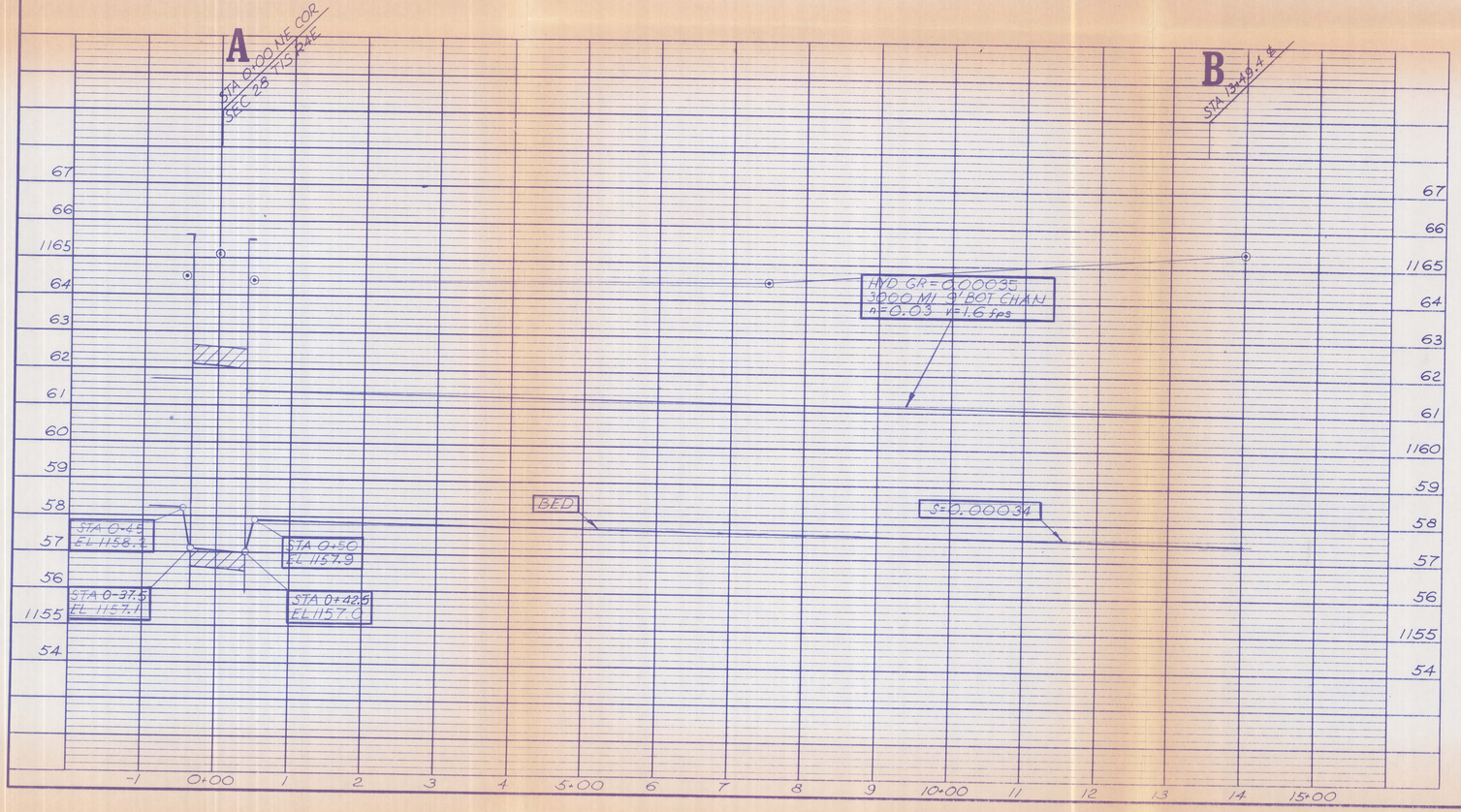
1-8-74	HJM	JP	RWS					AS BUILT STA 21+00 TO 26+90
8-3-72	HJM	HLG			BK			DESIGN STA 21+00 TO 26+90
REVISED	DSGN'R	DRAFT	CHECKED		APPROVED			DESCRIPTION

SALT RIVER VALLEY WATER USERS' ASSOCIATION
PHOENIX, ARIZONA

WASTE DITCH
SEC 11 T1S R4E
16/4 COR TO W4 COR

DRAWN HLG	CHKD	SCALE PLAN 1" = 30'	PRO HOR 1" = 100	VERT 1" = 5'
SHEET OF	0-874	7-10-72	B-112-351.2	





TBM:
NAIL N SIDE TRIPLE TRANS POLE SW COR INTER 21E-5S
EL 1167.09

CONSTRUCTION LEGEND
CONSTRUCTION BY S R V W U A
CONSTRUCTION BY PERMITTEE

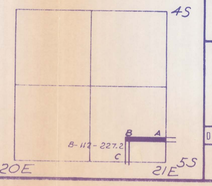
NOTE:
THE ASSOCIATION DOES NOT GUARANTEE THE LOCATION OR ELEVATION OF UTILITIES AND WILL NOT BE RESPONSIBLE FOR THEIR RELOCATION UNLESS OTHERWISE STATED.

ALL CONSTRUCTION BY PERMITTEE EXCEPT CULV DWG #6-155-1 BY MCHD

CAUTION:
LOCATION OF AT&T CABLE UNKNOWN. BEFORE EXCAVATING IN VICINITY OF AT&T CABLE, CALL 253-2424.

PLOTTED FROM WUA FIELD NOTES

SYMBOLS FOR PROFILE
- CENTER LINE OF ROAD
- LOW BANK
- BED
- AVERAGE GROUND LEFT
- AVERAGE GROUND RIGHT
- AVERAGE GROUND(ONE GIVEN)
- HIGH WATER
- CENTER LINE PVT SLIPFORM
- HI GROUND
- LOW GROUND



REVISED	BY	CHECKED	APPROVED	DESCRIPTION
7-14-69	IMM	AR	RWS	AS-BUILT
4-7-67		AR		DESIGN

SALT RIVER VALLEY WATER USERS' ASSOCIATION
PHOENIX, ARIZONA

TEMPE-GILA WASTE DITCH
SEC 28 T1S R4E
800' N SE COR TO 800' N 16/6 COR

DRAWN	CHKD	SCALE: PLAN	PRO HOR	VERT
		1"=30'	1"=100'	1"=2'

SHEET	JOB NO.	DATE	DRAWING NO.
2 OF 4	6-155	3-23-67	B-112-227.1

FCD Hydrology Summary

GILA DRAIN

6-8-81

GILA DRAIN HYDROLOGY

Items for Clarification or Additional Data

References cited are the watershed subareas or concentration points given in "Summary Report for Flood Control, Gila Floodway, Maricopa and Pinal Counties, Arizona" by the U.S. Army Corps of Engineers, Los Angeles District, September 1977. A map is attached for clarity.

General

As a general statement of the hydrologic findings, the Corps report provides limited information on 25, 50 and 100 year and Standard Project flood peak flow rate and volume for "Base Year" and "Future" watershed conditions (development) and only at those concentration points the Corps considered critical. The detail presented is not sufficient to allow the various jurisdictions to evaluate how a specific flood problem would be resolved under their respective ordinances. If the Corps hydrology is to be utilized as a data base for evaluation of various alternative concepts, the detailed working files for all subareas in the watershed lying west of the RWCD Floodway and south of the Superstition Freeway must be available for use. In addition, the results of a 10 year event on each of the subareas will need to be evaluated.

Why?

Omissions

The Corps southerly watershed boundary is roughly "Citrus Heights Road". Field observations indicate that during at least some level of precipitation, flow can reach the Gila Drain from a major subarea south of the Corps' limit. This area is bounded by "Citrus Heights Road" on the north, by the RWCD Floodway on the east and south, and by the Phoenix-Tucson No. 1-115kv Transmission Line on the west. The Sun Lakes development is encompassed by this area. The hydrology of this area should be evaluated for 10 year through 100 year events.

Items for Additional Study

1. City of Phoenix Drainage - The Corps projection for developments in evaluating "future" hydrology makes no specific reference to drainage policy within areas

under jurisdiction of Phoenix. Pima Ranch has been proposed subsequent to the Corps study and there is potential for additional development in the South Mountain area. Because of the high runoff potential and the opportunity of concentration of sheet flows into channels, "future" conditions flow projected by the Corps could well be low in both peak rate and volume. The specific action required to define these potentials is not clear. It is suggested that dialogue be established between the Flood Control District and Phoenix to define the studies needed.

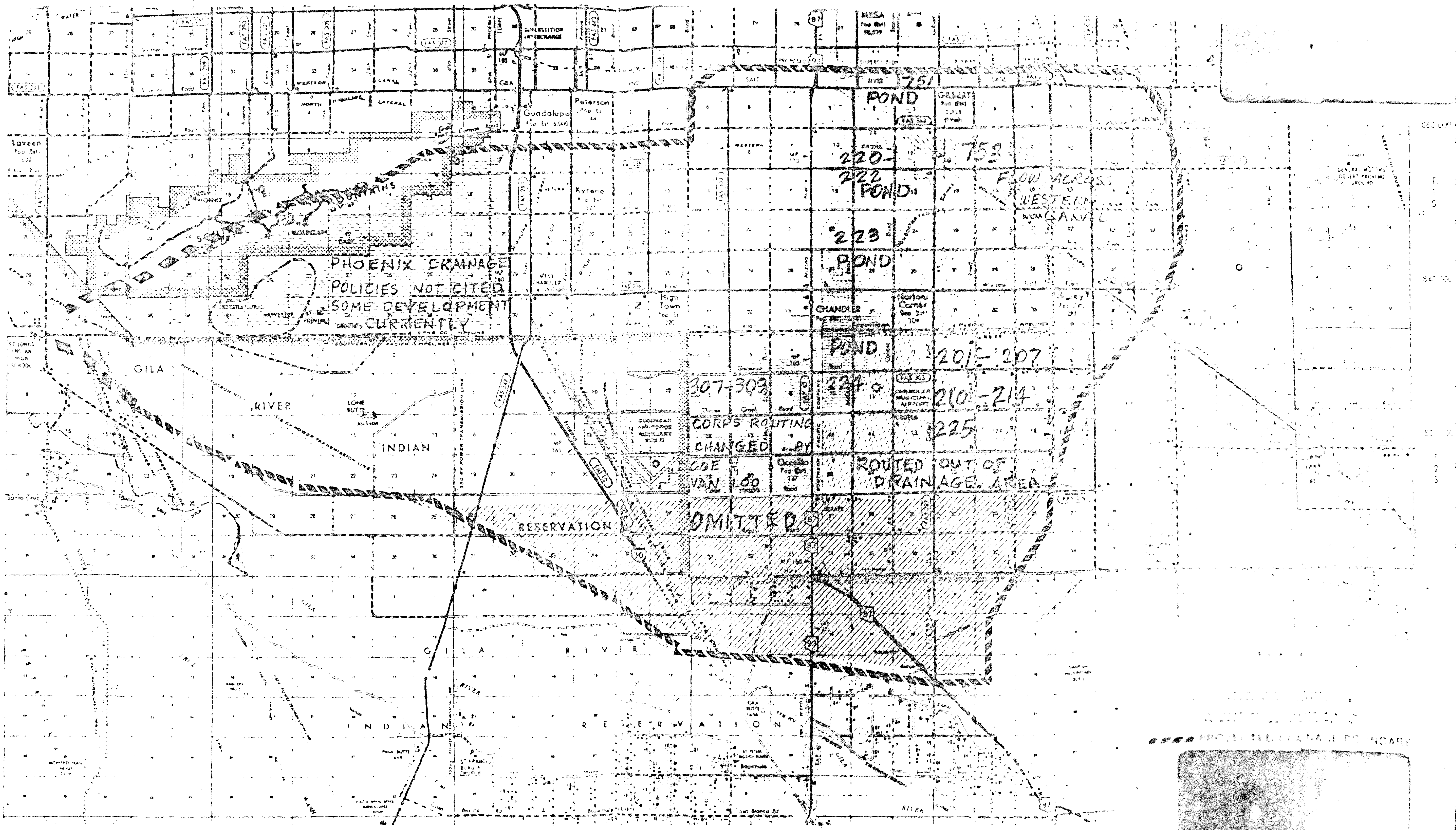
2. Drainage Subareas 307, 308 and 309. - The work done by Coe & Van Loo resulted in their removal of flows from these drainage areas as contributing to Concentration Point 1310 as assumed by the Corps. However, in routing these flows west under I-10, the Coe & Van Loo Report is unclear whether the flows were routed into the Gila Drain west of I-10 and at which location(s). This suggests that both the Corps and Coe & Van Loo assumptions be re-evaluated and the Coe & Van Loo routing be clarified.

3. Drainage Subareas 201-207, 210-214 and 225. - This point relates to the omitted watershed area previously discussed. The Corps hydrology assumes that flows reaching Concentration Point 1225, roughly "Citrus Heights Road" and Arizona Avenue, does not contribute to the Gila Drain. Observations tend to refute the assumption, at least for some levels of flooding. The Corps hydrology summary does not show values for peak flow and volume at Concentration Point 1225. This information will be required to evaluate flooding conditions for present and future conditions for Gila Drain alternatives.

4. Ponding, Drainage Subareas 220-224, 751 and 752. - The Corps hydrology shows zero outflow from these subareas up to and including the 100 year event. However, the existing irrigation delivery and tailwater system of Salt River Project includes numerous undercrossings of the Chandler Branch of the Southern Pacific. The potential exists for virtually all the ponded volume to discharge west at a reduced rate and eventually impact the Gila Drain, in terms of volume, if not in peak flow. The effect of these discharge opportunities should be evaluated both in terms of existing hydraulic parameters and future intentions of

the municipalities involved with regard to ponding and outflow. Overflow potential should also be re-evaluated in light of recent development plans.

5. Flows north from Drainage Subarea 221 and Flows from Concentration Point 1753. - The Corps shows outflow from Subarea 753 crossing the Western Canal in a northwesterly direction into Subarea 752. There is a potential for unmetered flow into the Western Canal beyond any which may have been considered by the Corps or Coe & Van Loo. Neither report clearly addresses this impact on flow of the Western Canal in terms of peak or volume discharged west from the respective areas. Evaluation should be made on the potential impact of peak and volume discharges into the Gila Drain and additionally the impact should be evaluated on the proposed schedule of metered release of detained waters by the various municipalities.



PHOENIX DRAINAGE
POLICIES NOT CITED
SOME DEVELOPMENT
CURRENTLY
751
POND
753
220-
222
POND
223
POND
FLOW ACROSS
WESTERN
CANAL
POND
201-207
307-309
224
210-214
225
CORPS ROUTING
CHANGED BY
COE
VAN LOO
ROUTED OUT OF
DRAINAGE AREA
OMITTED
Laveen
Guadalupe
Peterson
Kyrene
GILBERT
MESA
CHANDLER
GILA
RIVER
INDIAN
RESERVATION
GILA RIVER
INDIAN RESERVATION

111° 50′
111° 45′
112° 10′
112° 05′
112° 00′
111° 55′
EASTERN CANAL
CONSOLIDATED CANAL
RWCD
SPRR
SUPERSTITION FREEWAY
BROWN RD
BROADWAY RD
SOUTHERN AVE
BASELINE RD
NORTH END OF RWCD
GILA FLOODWAY
GILA RIVER
GILA RIVER INDIAN RESERVATION
INDIAN RESERVATION
SCALE
2 miles
401
402
403
403 A
404
405
411
501
502
503
504
551
552
553
554
555
556
601
602
603
604
651
652
653
701
751
752
753
101
104
122
123
201
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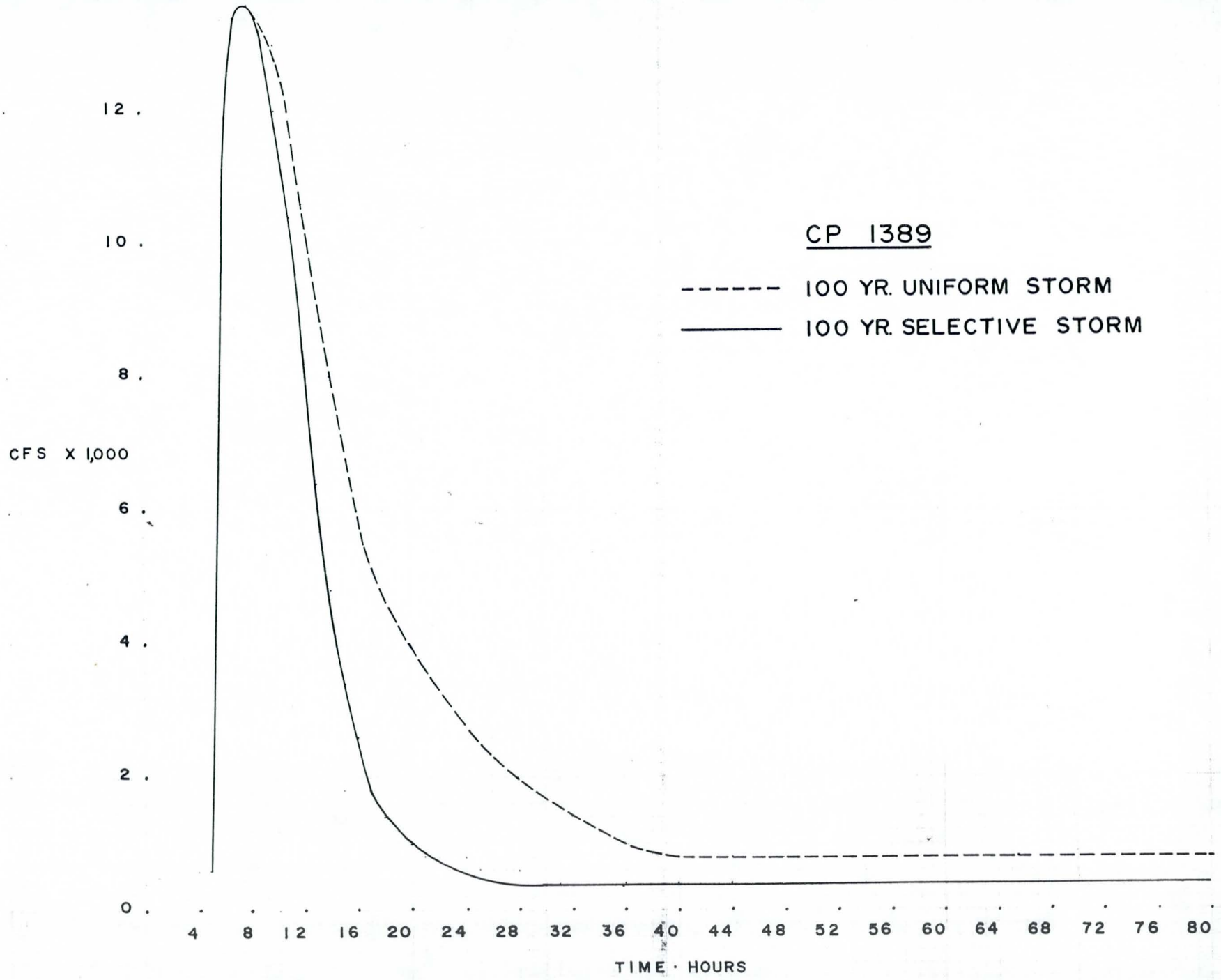
376
379
380
381
382
383
384.5
385
386
387
388
389
356.4
356.5
361.5
364.5
376.5
378
378.5
SPLIT
questionable


CP 1389
100 YR. UNIFORM STORM
100 YR. SELECTIVE STORM
CFS X 1,000
12.
10.
8.
6.
4.
2.
0.
4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68 72 76 80
TIME · HOURS

Check D.A. for 3.79

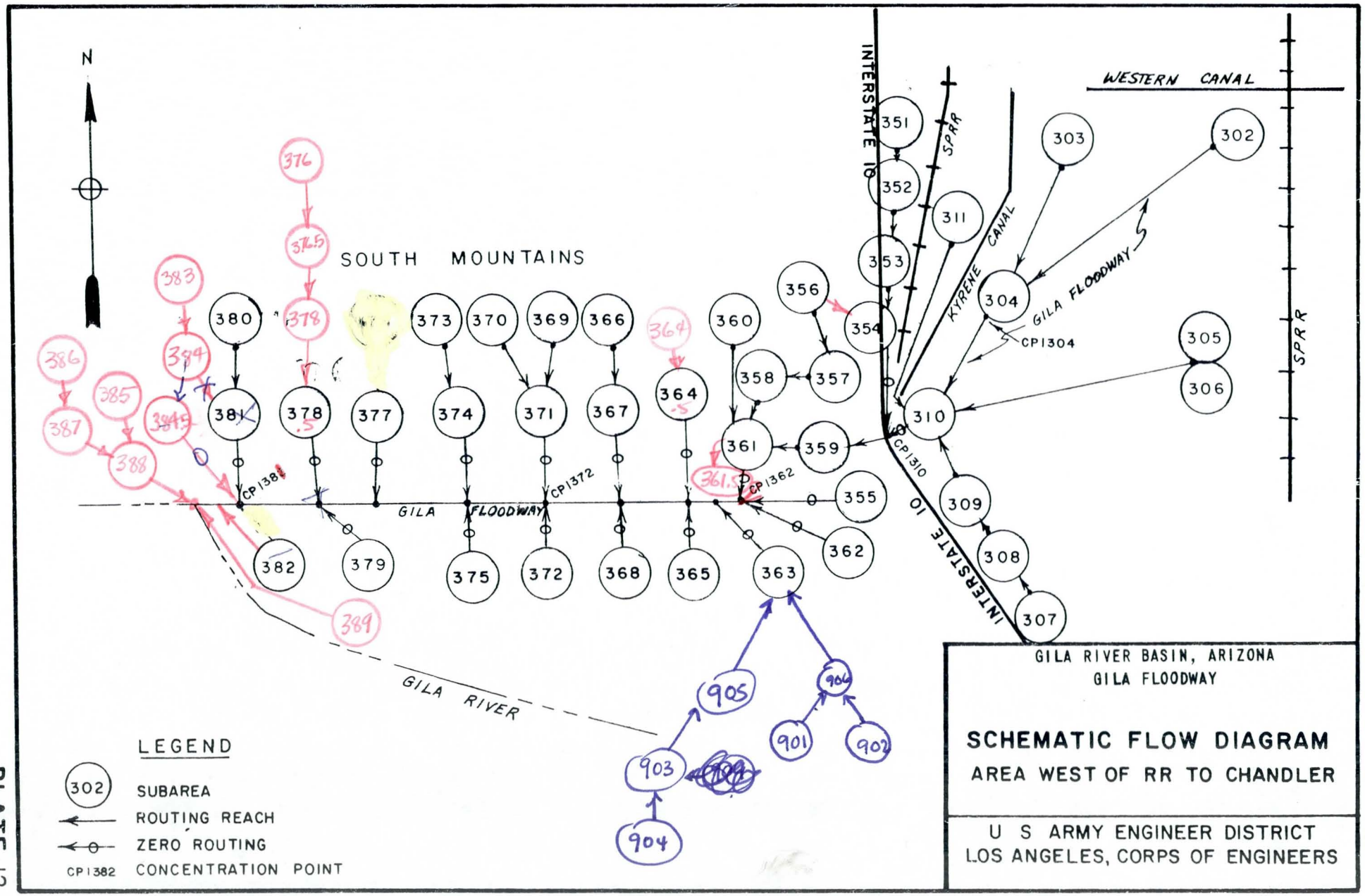
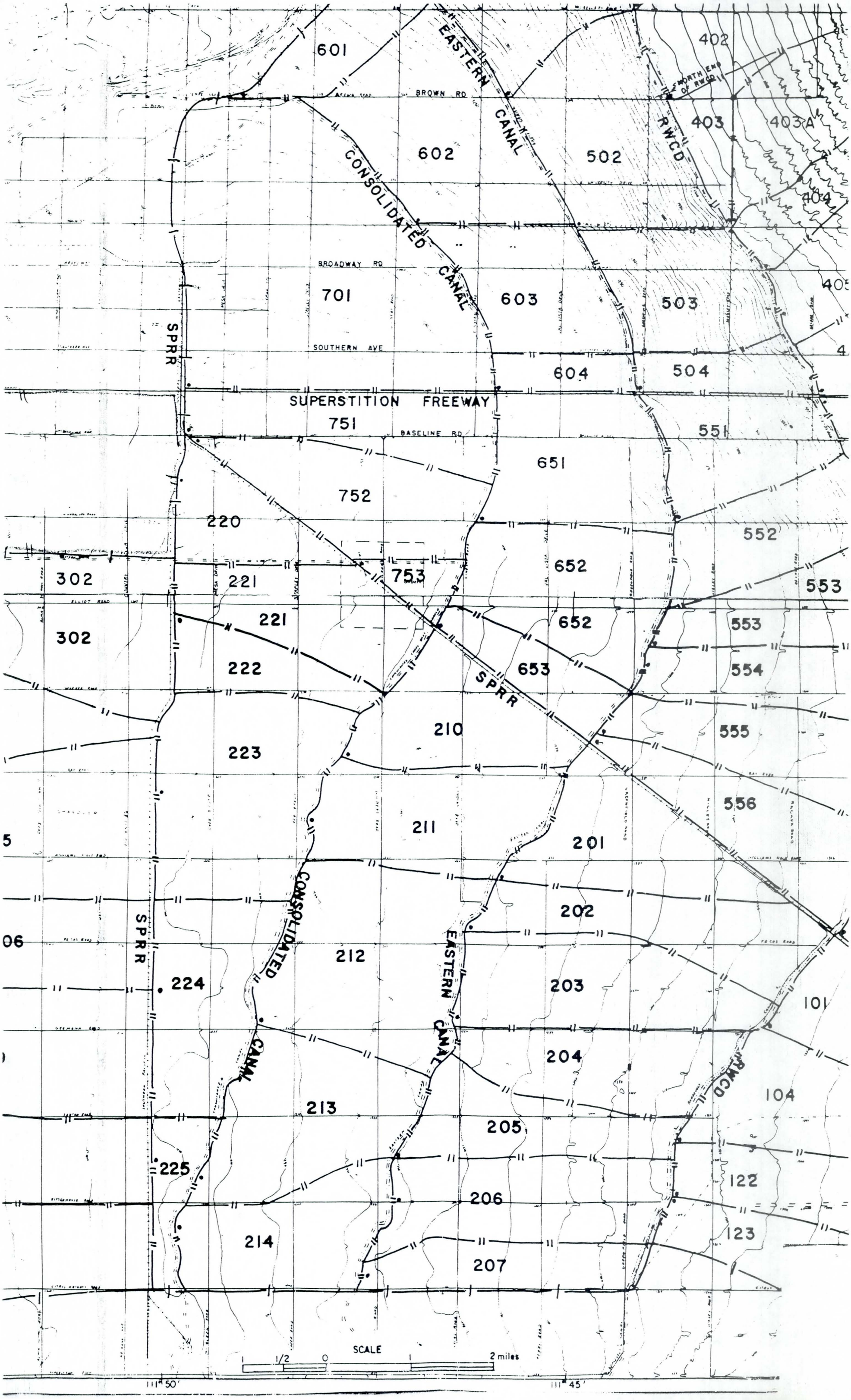
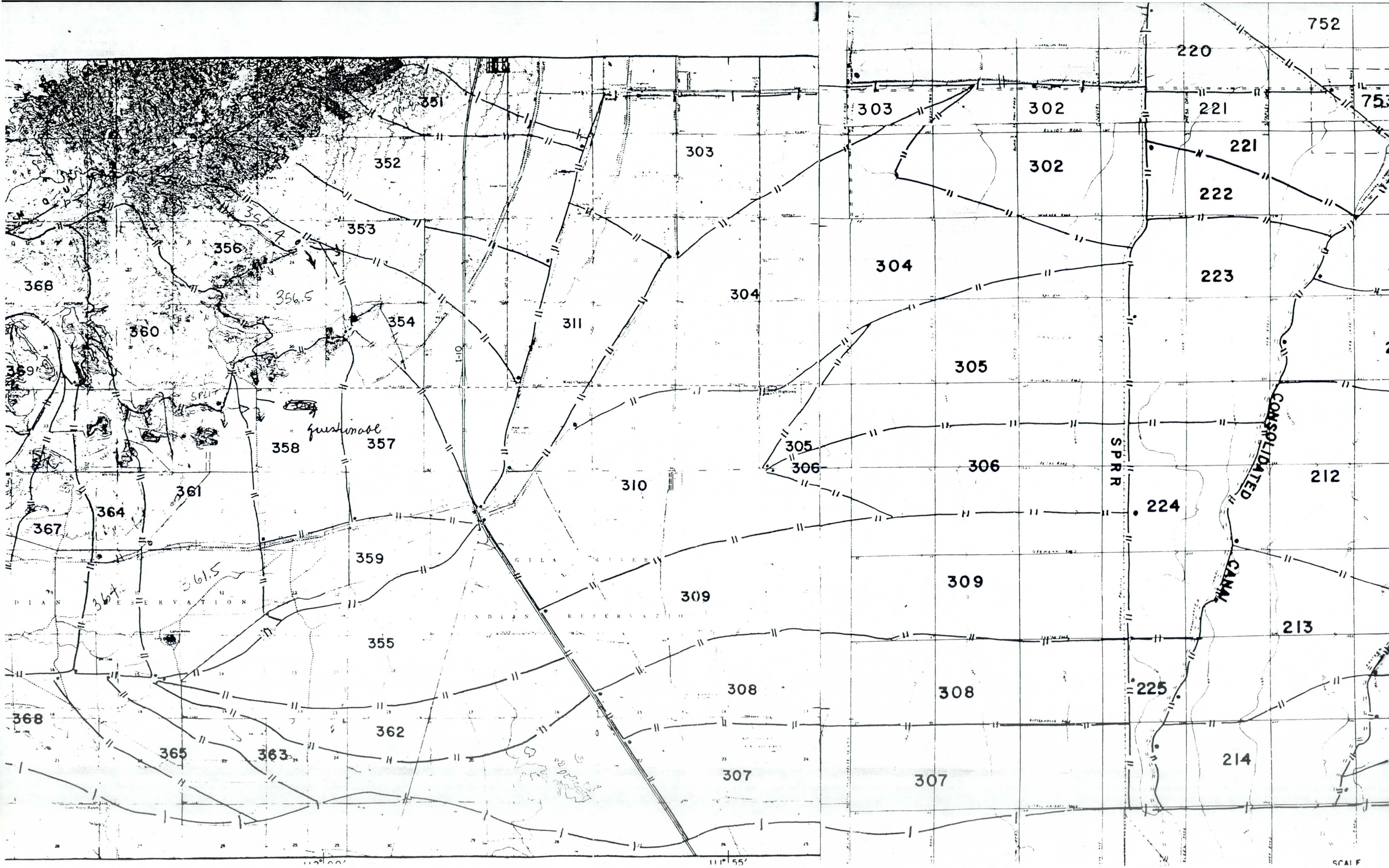
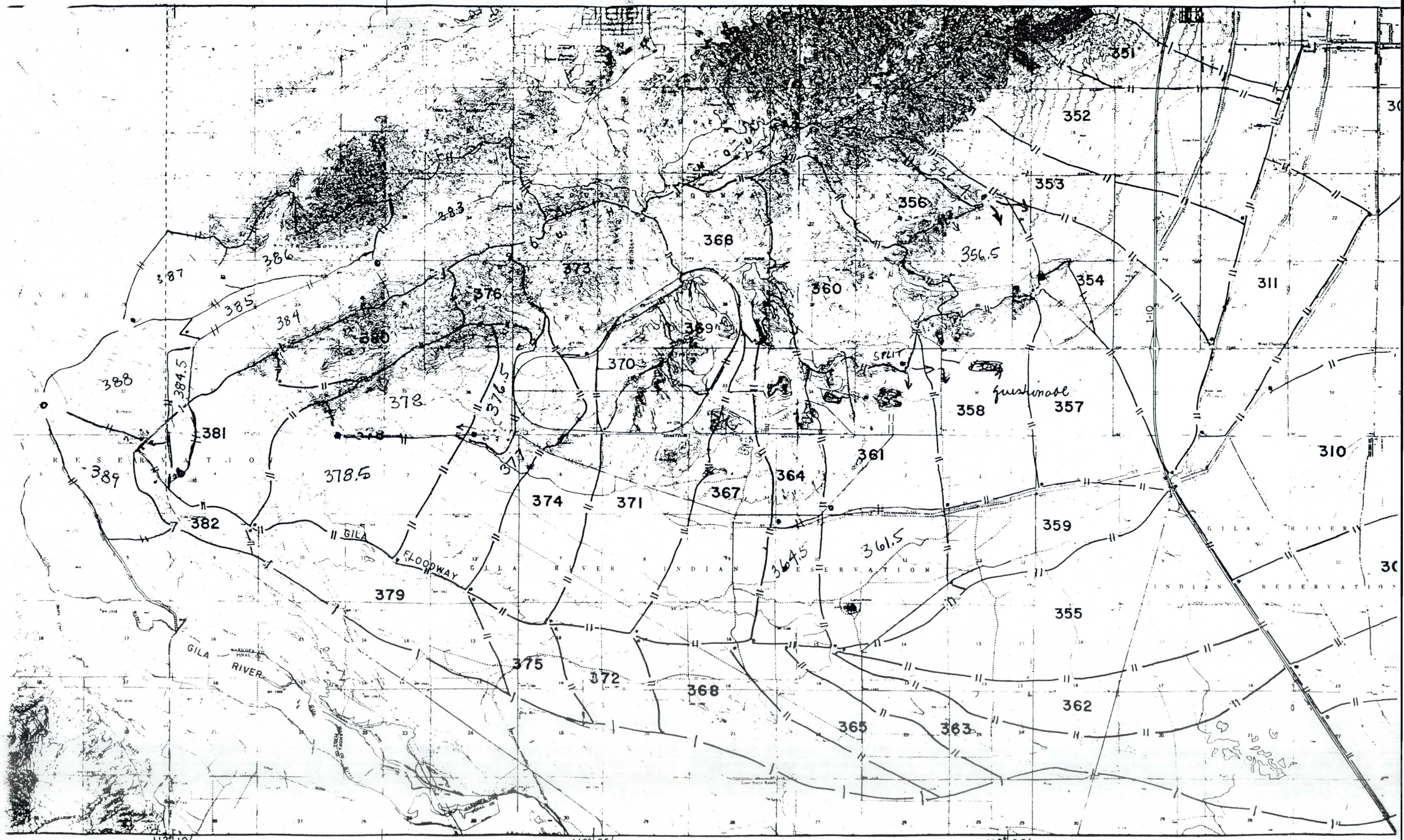


PLATE 12


601
EASTERN CANAL
BROWN RD
602
502
RWCD
403
403A
404
CONSOLIDATED CANAL
BROADWAY RD
701
603
503
SPRR
SOUTHERN AVE
604
504
SUPERSTITION FREEWAY
751
BASELINE RD
551
651
752
220
552
302
221
753
652
553
222
554
653
210
555
223
556
211
201
202
212
224
203
204
104
213
205
225
122
206
123
214
207
SCALE
1 1/2 0 1 2 miles
111° 50'
111° 45'



752
220
303
302
221
753
351
352
303
302
221
222
353
356.4
356
304
304
223
366
356.5
354
311
360
305
I-10
ELLIOT ROAD
WARNER ROAD
SPLIT
questionable
358
357
305
306
306
SPRR
CONSOLIDATED
CANAL
212
361
310
224
364
367
359
GILA RIVER
309
309
361.5
364
213
355
308
308
225
368
362
365
363
307
307
214
SCALE


351
352
353
356
356.4
356.5
354
311
310
360
368
373
376
383
386
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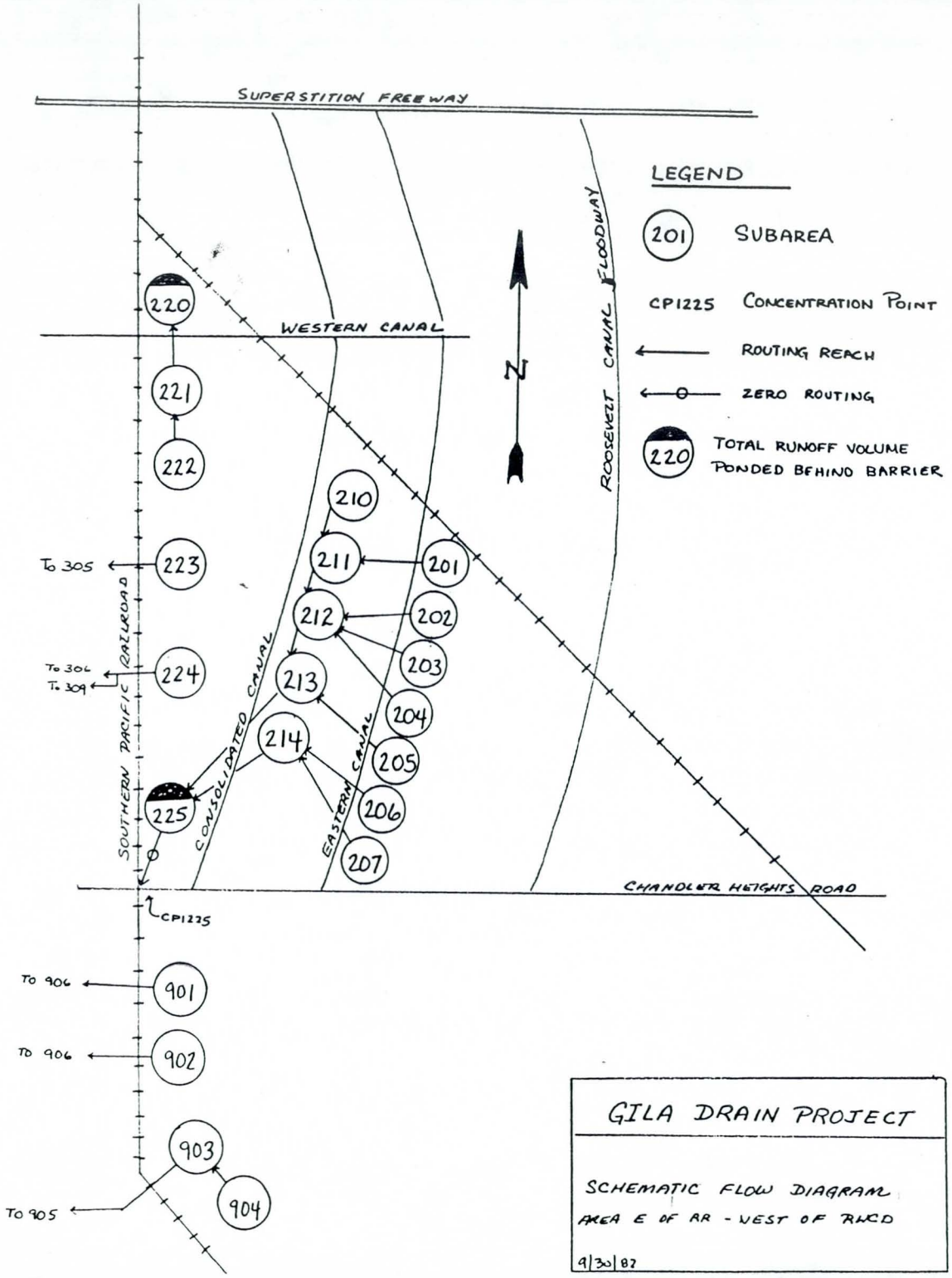
384.5
388
380
389
378
376.5
378.5
381
382
370
369
SPLIT
358
357
361
364
367
374
371
359
361.5
364.5
379
375
372
368
365
363
362
355
GILA
FLOODWAY
GILA RIVER INDIAN RESERVATION
GILA RIVER
MARICOPA CO
PINAL CO
112°10'
112°05'
112°00'

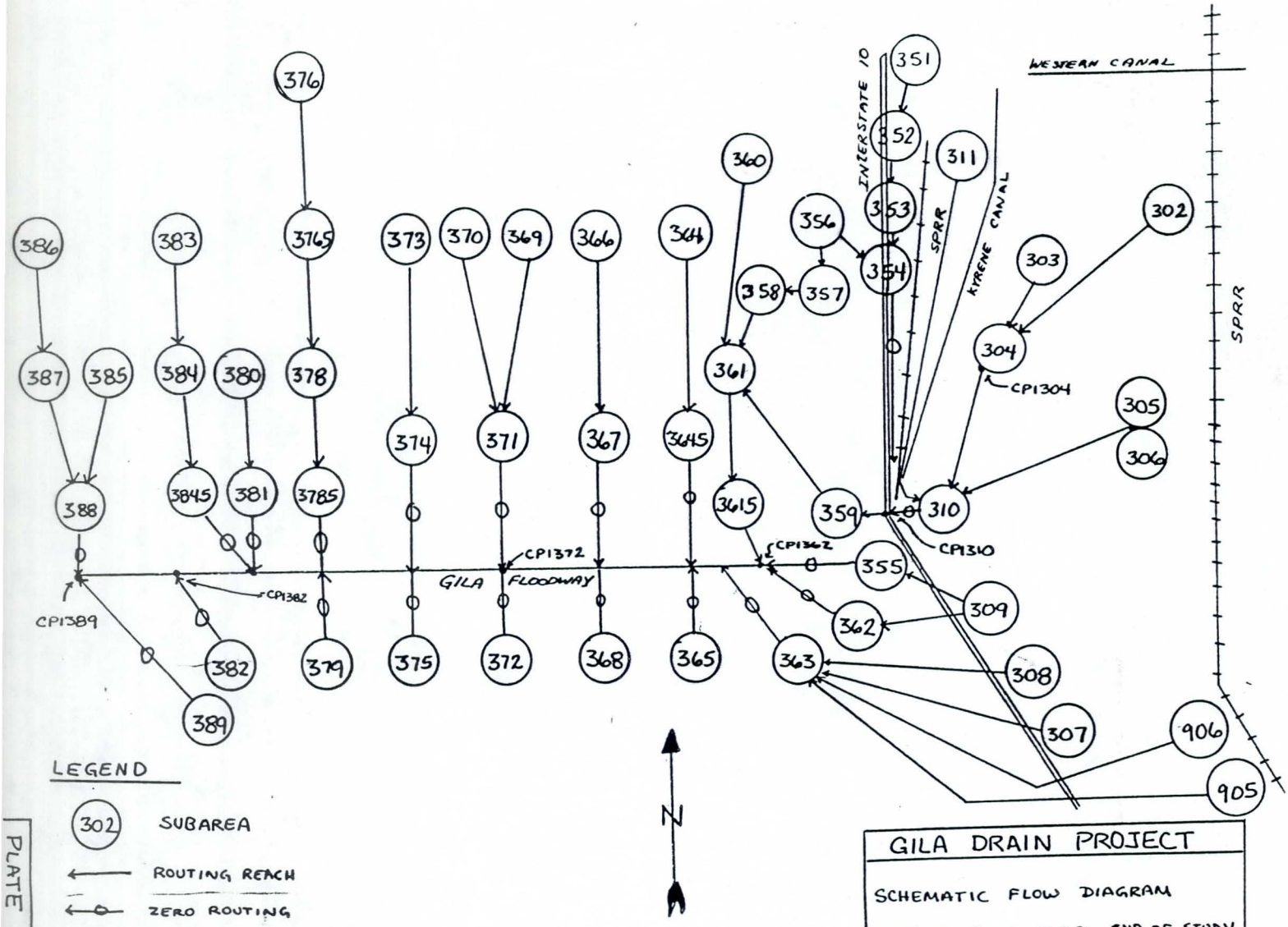


GILA DRAIN PROJECT

SCHEMATIC FLOW DIAGRAM
AREA E OF RR - WEST OF RWCD

9/30/82

PLATE



LEGEND

302 SUBAREA

← ROUTING REACH

←o— ZERO ROUTING

CP 1389 CONCENTRATION POINT

PLATE

GILA DRAIN PROJECT

SCHEMATIC FLOW DIAGRAM

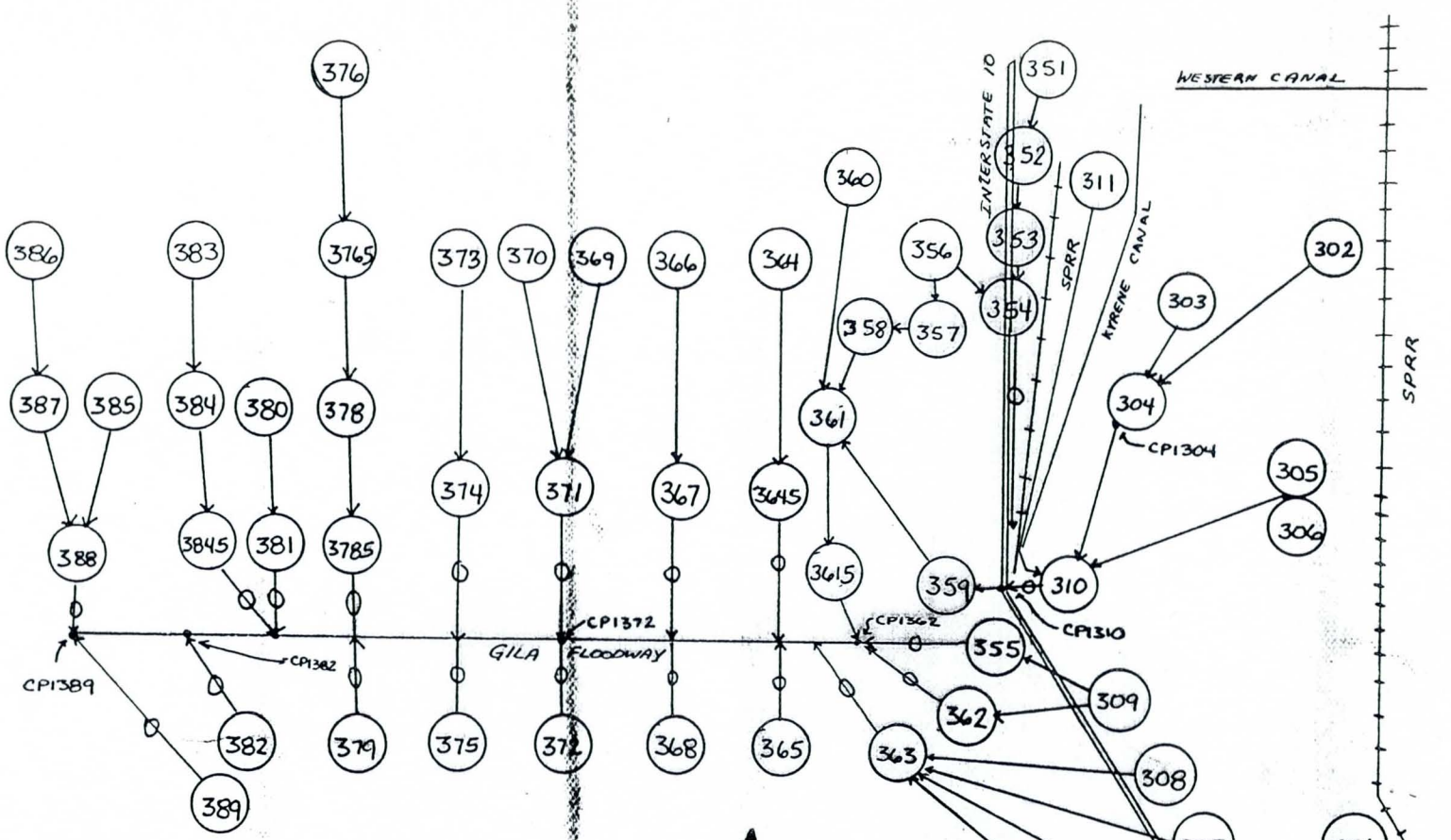
AREA WEST OF SPRR - END OF STUDY

4/30/82

ROAD
DRIVE
KNOX
AVENUE
STREET
R. R.
PACIFIC
ROAD
ROAD
STREET
ROAD
RAY
IVANHOE
GALVESTON
ERIE
WILLIAMS
HARTFORD
TRANSPORTATION PROJECT AREA
18"
STREET
STREET
FIELD
HAMILTON
ROAD
COOPER
CANAL
ROAD
BOX CULVERT
ARROWHEAD
SCHOOL
DENVER (FRYE)
ABAND. S.T.P.
ROAD
ARIZONA DEPT. OF DRAINAGE
SOUTHERN
MC QUEEN
12"
ALMA
PECOS
ARIZONA
ROAD
EAST BRANCH CONSOLIDATED
PROPOSED ARIZ. DEPT. OF TRANSPORTATION BASIN
1" = 1000'

LEGEND

- (2) DRAINAGE AREA
- RETENTION AREA
- 18" PIPE DRAINAGE, DIAMETER INDICATED
- DITCH DRAINAGE
- PECOS FLOODWAY
- INLET STRUCTURE
- CONCENTRATION POINT



LEGEND

302 SUBAREA

ROUTING REACH

ZERO ROUTING

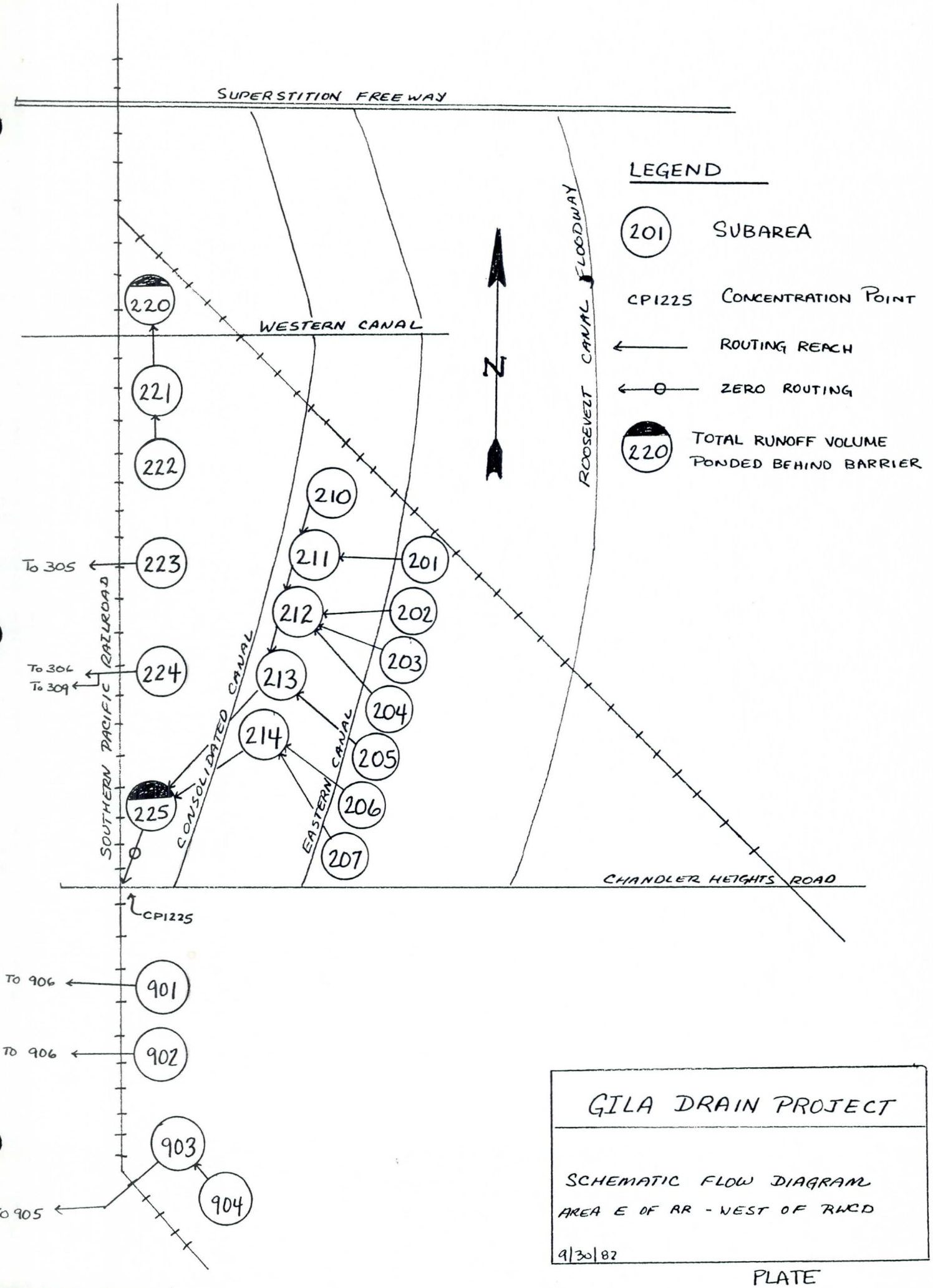
CP 1389 CONCENTRATION POINT

PLATE

GILA DRAIN PROJECT

SCHEMATIC FLOW DIAGRAM

AREA WEST OF SPRR - END OF STUDY

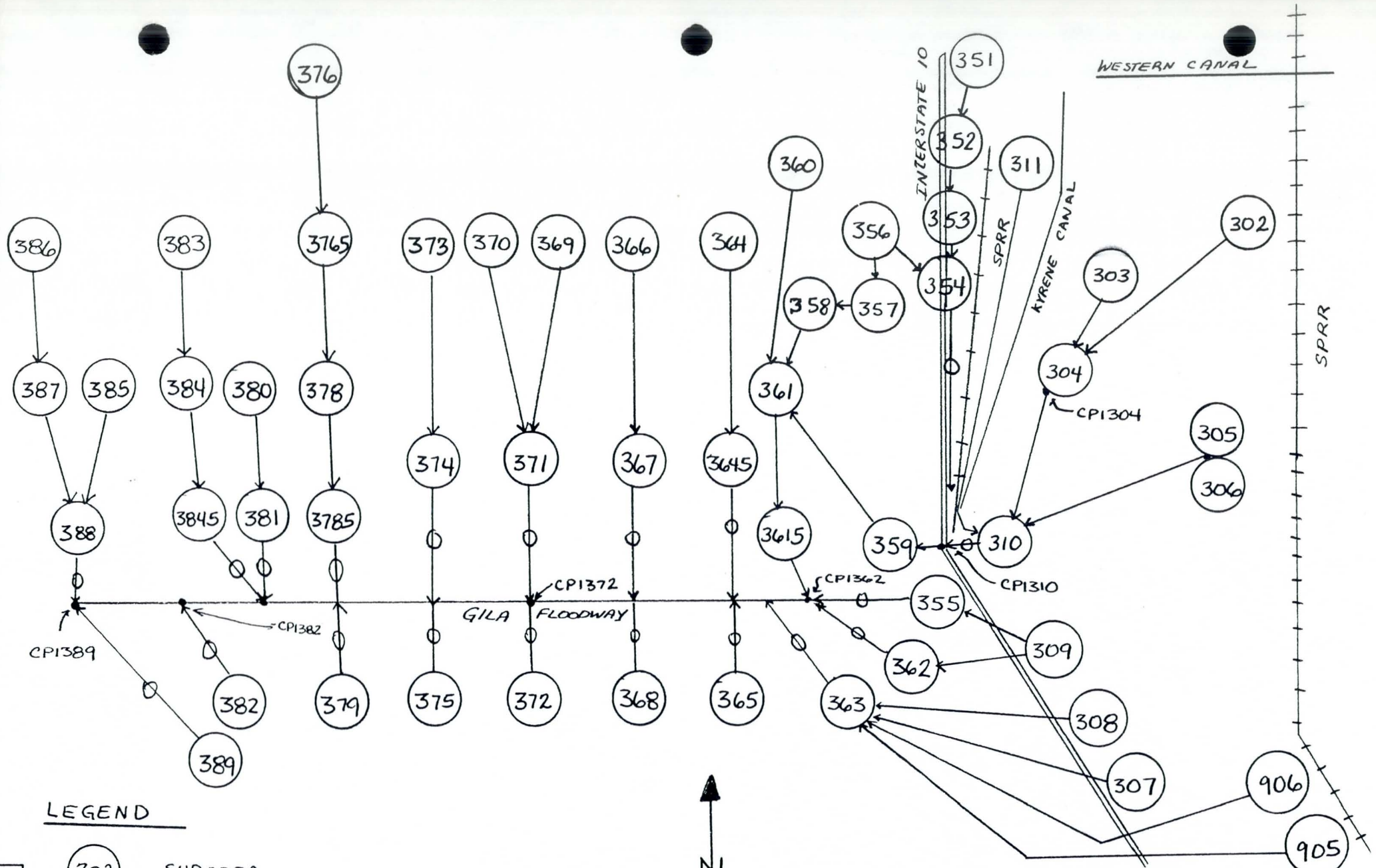


GILA DRAIN PROJECT

SCHEMATIC FLOW DIAGRAM
AREA E OF AR - WEST OF RWCD

9/30/82

PLATE



LEGEND

302 SUBAREA

← ROUTING REACH

←o ZERO ROUTING

CP 1389 CONCENTRATION POINT

PLATE

GILA DRAIN PROJECT

SCHEMATIC FLOW DIAGRAM

AREA WEST OF SPRR - END OF STUDY

4/30/82

TABLE
Subarea Characteristics
Present and Future Conditions

Subarea Designation No.	Drainage Area (sq. mi.)	L (mi.)	Slope (ft/ft)	Manning's n	Percent Imperviousness
1	0.97	0.72	0.0053	0.050	0
2	3.77	6.06	0.0042	0.070	0
4	0.88	1.40	0.0047	0.050	0
5	4.33	4.74	0.0044	0.065	0
6	4.24	5.31	0.0036	0.070	0
7	1.36	1.48	0.0045	0.050	0
8	3.92	3.71	0.0040	0.070	0
9	2.37	1.90	0.0045	0.050	0
10	2.29	3.52	0.0038	0.070	0
11	1.56	1.93	0.0044	0.050	0
12	2.38	2.88	0.0040	0.070	0
13	0.77	1.74	0.0044	0.050	0
14	2.03	3.11	0.0034	0.070	0
23	2.83	2.88	0.0042	0.050	0
21	3.9	2.73	0.0030	0.070	0

TK 3/24/77

TABLE
Subarea Characteristics
Present and Future Conditions

Subarea Designation No.	Drainage Area (sq. mi.)	L (mi)	Slope (ft/ft)	Manning's n	Percent Imperviousness
101	3.82	4.55	0.0030	0.070	0
102	1.48	2.84	0.0036	0.070	0
103	3.15	5.31	0.0030	0.070	0
104	3.57	4.17	0.0030	0.070	0
105	2.29	2.35	0.0021	0.065	0
106	4.75	3.30	0.0066	0.060	0
108	1.04	2.84	0.0063	0.065	0
110	2.58	2.27	0.0051	0.070	0
114	4.16	3.68	0.0053	0.070	0
115	1.35	2.99	0.0021	0.070	0
118	3.14	3.64	0.0057	0.070	0
121	4.51	7.20	0.0032	0.065	0
122	4.05	5.95	0.0030	0.070	0

See plates 5, 6, and 7 for location

TK 3/24/77

TABLE
Subarea Characteristics
Present and Future Conditions

Subarea Designation No.	Drainage Area (sq. mi.)	L (mi)	Lca (mi)	Slope (ft/mi.)	Basin n	Percent Imperviousness
107	1.07	2.43	0.91	48	0.030	0
109	3.37	4.17	2.08	55	0.035	0
111	1.84	3.56	1.59	115	0.035	0
112	1.01	1.40	0.57	179	0.035	0
113	2.55	3.52	1.86	183	0.040	0
116	1.21	2.24	0.57	63	0.035	0
117	2.49	4.36	2.84	153	0.045	0
119	3.06	3.11	1.67	209	0.045	0
120	4.37	4.17	2.08	161	0.045	0

See plat. 7 for location

TK 3/25/77

TABLE
Subarea Characteristics
Present and Future Conditions

Subarea Designation No.	Drainage Area (sq. mi.)	L (mi.)	Slope (ft./ft.)	Manning's n		Percent Imperviousness	
				Present	Future	Present	Future
401	2.41 (1.6)	3.68	0.0110	0.040	0.040	15	15
402	2.56 (1.8)	3.45	0.0117	0.055	0.055	10	10
403	4.21 (3.6)	4.74	0.0087	0.045	0.045	10	20
404	1.94 (1.7)	4.32	0.0097	0.045	0.045	15	20
405 *	4.34	4.17	0.010	0.050	0.045	10	20
406	1.58	3.18	0.0110	0.045	0.045	10	10
406A	6.00	4.55	0.010	0.050	0.050	5	5
406B	0.40	0.87	0.0076	0.050	0.050	0	0
407	1.74	3.26	0.0099	0.050	0.050	5	5
407A	2.82	3.87	0.0110	0.050	0.050	0	0
408	2.12	3.34	0.0082	0.050	0.045	0	10
408A	1.88	2.12	0.0076	0.050	0.050	0	0

( ) actual contributing drainage area due to citrus area

* On-site storage accounted for in future conditions

See plates 3 and 4 for location

TK

3/25/77

TABLE
Subarea Characteristics
Present and Future Conditions

Subarea Designation No.	Drainage Area (sq. mi.)	L (mi.)	Slope (ft/ft.)	Mannings n		Percent Imperviousness	
				Present	Future	Present	Future
409	4.56	3.9	0.0114	0.050	0.045	5	15
410	7.58	4.55	0.0102	0.045	0.040	10	25
411	4.44	4.24	0.0064	0.045	0.045	15	20
451	2.39	4.93	0.0064	0.060	0.050	0	15
452	4.49	3.94	0.0066	0.065	0.065	0	0
453	3.38	5.61	0.0064	0.050	0.050	0	0
454	4.28	6.44	0.0066	0.050	0.050	0	0
455	1.05	1.29	0.0089	0.050	0.050	0	0
456	5.98	4.62	0.0059	0.050	0.050	0	0
457	10.28	8.53	0.0053	0.050	0.050	0	0
458	4.53	6.94	0.0044	0.050	0.050	0	0
459	1.53	1.82	0.0027	0.050	0.050	0	0
460	5.21	4.89	0.0045	0.050	0.050	0	0

See notes 3 and 5 for location

TABLE
Subarea Characteristics
Present and Future Conditions

Subarea Designation No.	Total Area (sq. mi.)	† Contributing Drainage Area Present	Future	L (mi)	Slope (ft/ft)	Manning's n Present	Future	Percent Imperviousness Present	Future
551	2.24	1.68	1.68	2.84	0.0055	0.070	0.070	0	0
552	2.26	2.26	2.26	2.92	0.0045	0.070	0.070	0	0
553	2.63	2.63	2.63	3.18	0.0042	0.070	0.070	0	0
554	2.42	2.42	2.42	3.07	0.0031	0.070	0.070	0	0
555	2.82	2.82	2.82	3.68	0.0027	0.070	0.070	0	0
556	3.04	3.04	3.04	3.79	0.0028	0.070	0.070	0	0
651 *	3.02	3.02	3.02	2.77	0.0033	0.070	0.045	0	20
652 *	3.35	3.30	3.35	2.39	0.0025	0.070	0.065	0	5
653 *	1.43	1.43	1.43	2.27	0.0025	0.070	0.060	0	10
701	9.91	9.91	9.91	4.21	0.0028	0.040	0.040	25	25
751 **	2.40	2.40	2.40	3.64	0.0019	0.060	0.040	5	25
752 **	3.23	3.23	3.23	3.60	0.0017	0.065	0.040	0	25
753 **	0.45	0.39	0.45	1.14	0.0022	0.040	0.035	25	35

* On-site storage accounted for in future conditions
** On-site storage accounted in both present and future conditions
† Due to offsite area

TR

3/29/77

TABLE
Subarea Characteristics
Present and Future Conditions

Subarea Designation No.	Drainage Area (Sq. mi.)	L (mi.)	Slope (ft/ft)	Manning's n Present	Manning's n Future	Percent Imperviousness Present	Percent Imperviousness Future
201	2.89	3.41	0.0023	0.070	0.070	0	0
202	3.20	4.17	0.0025	0.070	0.070	0	0
203	3.30	4.43	0.0031	0.070	0.070	0	0
204	2.55	3.30	0.0031	0.070	0.070	0	0
205	2.33	3.45	0.0035	0.070	0.070	0	0
206	3.38	3.80	0.0032	0.070	0.070	0	0
207	1.56	3.26	0.0033	0.070	0.070	0	0
210 *	2.75	2.58	0.0026	0.070	0.060	0	5
211 *	3.32	3.30	0.0022	0.065	0.060	0	5
212 *	4.86	3.03	0.0025	0.070	0.055	0	10
213	3.70	3.34	0.0028	0.070	0.070	0	0
214	2.66	2.54	0.0026	0.070	0.070	0	0

* On-site storage accounted for in future conditions

** On-site storage accounted for in both present and future conditions
See plate 6 for location

TC

3/9/77

TABLE

Subarea Characteristics
Present and Future Conditions

Subarea Designation No.	Drainage Area (sq. mi.)	L (mi)	Slope (ft/ft)	Manning's Present	Manning's Future	Percent Imperviousness Present	Percent Imperviousness Future
220 *	1.65	1.97	0.0018	0.070	0.035	0	35
221 **	2.69	3.15	0.0018	0.060	0.035	10	30
222 *	1.43	2.69	0.0016	0.070	0.040	0	30
223 *	4.82	3.07	0.0026	0.065	0.035	5	30
224 *	3.07	1.90	0.0020	0.065	0.040	0	30
225	0.94	0.83	0.0027	0.070	0.070	0	0

TK 3/29/17

* On-site storage accounted for in future conditions

** On-site storage accounted for in both present and future conditions
See Plate 6a for location

TABLE
Subarea Characteristics
Present and Future Conditions

Subarea Designation No	Drainage Area (sq. mi.)	L (mi)	Slope (ft/ft)	Manning's n Present	Manning's n Future	Percent Imperviousness Present	Percent Imperviousness Future
354 *	2.88	3.90	0.0090	0.060	0.040	0	30
355	4.95	4.40	0.0024	0.050	0.050	0	0
357 *	2.38	3.40	0.0058	0.065	0.050	0	15
358	2.60	3.00	0.0068	0.065	0.065	0	0
359	1.86	2.65	0.0019	0.050	0.050	0	5
361	4.03	3.83	0.0069	0.055	0.055	0	0
362	2.69	5.12	0.0020	0.050	0.050	0	0
363	4.48	6.82	0.0019	0.050	0.050	0	0
364	2.49	4.74	0.0231	0.050	0.050	0	0
365	1.73	3.40	0.0021	0.050	0.050	0	0
367	2.72	4.28	0.0091	0.055	0.055	0	0
368	2.23	3.87	0.0022	0.060	0.060	0	0

* On-site storage accounted for in future conditions

See plate 8 for location

TR

3/29/76

TABLE
Subarea Characteristics
Present and Future Conditions

Subarea Designation No.	Drainage Area (sq. mi.)	L (mi.)	Slope (ft/ft)	Manning's n		Percent Imperviousness	
				Present	Future	Present	Future
371	3.48	4.43	0.0099	0.055	0.055	0	0
372	1.01	1.74	0.0038	0.060	0.060	0	0
374	2.15	3.64	0.0098	0.055	0.055	0	0
375	0.86	2.05	0.0035	0.055	0.055	0	0
377	3.03	3.98	0.0156	0.055	0.055	0	0
378	4.04	4.06	0.0333	0.050	0.050	0	0
379	2.00	3.56	0.0024	0.050	0.050	0	0
381	2.14	3.60	0.0496	0.050	0.050	0	0
382	0.44	1.03	0.0074	0.050	0.050	0	0

See plate 8 for location

TK

3/29/76

TABLE
Subarea Characteristics
Present and Future Conditions

Subarea Designation No.	Drainage Area (sq. mi.)	L (mi.)	Lca (mi.)	Slope (ft/mi)	Basin n Present	Basin n Future	Percent Imperviousness Present	Percent Imperviousness Future
351 **	1.34	3.03	1.78	.0189 100	0.030	0.020	15	25
352 **	4.35	4.47	2.25	.0320 169	0.040	0.025	10	20
353 *	3.45	5.53	3.00	.0420 222	0.035	0.025	0	15
356	3.49	4.74	1.62	.0537 284	0.045	0.045	0	0
360	3.09	3.30	1.59	.0619 327	0.045	0.045	0	0
366	1.56	2.39	1.59	.1042 550	0.045	0.045	0	0
369	0.94	1.97	0.83	.0231 122	0.045	0.045	0	0
370	0.64	1.67	0.87	.0341 180	0.045	0.045	0	0
373	2.17	2.46	1.86	.0884 467	0.045	0.045	0	0
376	0.76	1.44	0.83	.1242 656	0.045	0.045	0	0
380	1.41	2.50	1.33	.0697 368	0.045	0.045	0	0

* On-site storage accounted for in future conditions

** On-site storage accounted for in both present and future conditions

See plate 8 for location

TK

3/19/76

WATERSHED WORKSHEET FOR GILA DRAIN

SUB-AREA DESIGNATION	AREA (MI^2)	SLOPE ft/ft	L miles	L_{ca} miles	LAND USE	PRESENT "n"	FUTURE "n"	PRESENT % IMPERV.	FUTURE % IMPERV.	COMMENTS
901	6.19	.0025 ~~.0002~~	5.98 ~~3.71~~		AG - 100					
902	5.37	.0031 ~~.0035~~	5.11		AG - 100					elev. outfall = ~~1219.00~~ 1217.
903	5.29	.0037	3.95		AG - 100					R.L. 2.73
904	1.81 ~~1.21~~	.0048	2.23 ~~1.98~~		AG - 100					
905	12.10	.0018	6.52		10 - AG 90 - HI LOSS NAT.					R.L. for 903 = 4.69
906	8.89	.0016	5.81		$2mi^2$ - SUNLAKES rest - AG -					
363	11.69	.0017 ~~.0018~~	10.52		100 - NAT.					R.L. for 905 = 9.21 906 = 7.95
365	3.64	.0017	7.69		50 - AG 50 NAT.					

WATERSHED WORKSHEET FOR GILA DRAIN

SUB-AREA DESIGNATION	AREA (MI^2)	SLOPE ft/ft	L miles	L_{ca} miles	LAND USE	PRESENT "n"	FUTURE "n"	PRESENT % IMPERV.	FUTURE % IMPERV.	COMMENTS
356.4	.33	.1147	1.7	.71		.045		0		356A in HEC
356.5	1.42	.0085	1.45	.61		.060		0		356 B in HEC
356.	~~1.78~~ 1.74	.0601	3.62	1.20		.045		0		
361.5	2.10	.0039	1.90	1.15		.060		0		361A in run routing length=1.6
361	1.93	~~.0521~~ .0239	2.40	.92		.055		0		
364.5	1.05	.0044	1.69	.91		.060		0		364A in run
364	1.44	.0521	~~1.64~~ 2.10	~~.91~~ 1.43		.050		0		
376.5	.42	.0989	~~2~~ 1.60	.67		.050				377A in run
377	2.61	.0184	3.98	1.26		.055				
378.5	2.08	.0071	2.19	1.25		.055				378A in run
378	1.96	.0582	2.43	.95		.050				
381	1.79	.0496	2.30	.61		.055				
382	.78	.0071	1.96	1.21		.055				
384	1.50	~~.0497~~ .042	~~2.47~~ 2.83	1.47		.050				
384.5	~~.384~~ .38	~~.0012~~ .006	1.52	.73		.055				384A in run
385	.42	.028	1.23	.51		.055				~~Combined with 388~~
386	1.37	.113	2.23	1.10		.050				

WATERSHED WORKSHEET FOR GILA DRAIN.

SUB-AREA DESIGNATION	AREA (MI^2)	SLOPE ft/ft	L miles	L_{ca} miles	LAND USE	Present "n"	Future "n"	Present % Imperv.	Future % Imperv.	COMMENTS
387	1.00	.0150	1.39	.98		.055		0		
388	1.50	.0052	1.81	1.11		.100				high "n" for dikes.
389	1.46	.0027	2.0	1.0						
901										
902										
903										
904										
905										
906										
907										
379 (check)										
383	2.10	.0911 ~~.069~~	2.15	1.13		.045				TC = .43 R = .0-37

Boyle Engineering Corporation

consulting engineers / architects

Suite 200
7807 Convoy Court
San Diego, California 92111

619/268-8080

CITY OF MESA
Attention: Mr. Harry Kent
City Engineer
P.O. Box 1466
Mesa, AZ 85201

January 9, 1984

GILA DRAIN - WESTERN CANAL ALTERNATIVE

At the project meeting on December 21, 1983 you gave us the following data:

1. The City of Mesa needs capacity for 100 cfs or 130 cfs, depending on whether or not Motorola is included.

2. A rate of 100 cfs or 130 cfs will drain the City of Mesa retention basins in 10 days.

3. The rate of 100 cfs or 130 cfs will be input to the Western Canal from the retention basin that is just east of Price Road and just north of the Western Canal. There will be no input at the Dobson Road retention basin.

If any of this data is not correct, please let us know. Also, in order to determine when pumping can be started, we need an inflow hydrograph for the retention basin at Price Road and the Western Canal. Assume the 100-year, 3.14-inch, 7-hour storm used by the Corps, Maricopa County, and Coe and Van Loo.

If you have any questions or would like to discuss the project, please call.

BOYLE ENGINEERING CORPORATION

Donald L. MacFarlane

Donald L. MacFarlane, PE
Associate Civil Engineer

llf

SD-M04-102-50

cc: Kent Dibble, Dibble and Associates
Tom LaMarche, County of Maricopa
Jim Nichols, BEC Phoenix

FLOOD CONTROL DISTRICT
RECEIVED
JAN 11 '84

	CH ENG		HYDRO
	ASST		LMgt
	ADMIN		SUSP
	C & O		FILE
	ENGR		DESTROY
	FINANCE	1	TOL
REMARKS			

CITY OF TEMPE

Home of Arizona State University

Office of the
Mayor and City Manager

P.O. Box 5002

Tempe, Arizona 85281

(602) 967-2001

May 5, 1982

FLOOD CONTROL DISTRICT
RECEIVED
MAY 06 '82

4	CH ENG	5	HYDRO
3	ASST		LMgt
	ADMIN		SUSP
	C & O	5	FILE LB
	EMOD		DESTROY
	FINANCE	2	SMB
REMARKS			

Mr. Thomas R. Lammers
State Engineer
Arizona Department of Transportation
206 South 17th Avenue - Room 102-A
Phoenix, AZ 85007

Re: Gila Drain Diversion Channel and ADOT Borrow Pit Site

Dear Tom:

The enclosed drawing shows the proposed location of the Gila Drain Diversion Channel extending from Elliot Road south to the ADOT borrow pit lying one quarter mile south of Warner Road. This channel will be located immediately east of the I-10 Freeway and intercept the storm water runoff emanating from that portion of South Mountain as indicated on the drawing, which runoff passes under the Freeway through the numerous pipe and box culvert crossings.

Although this channel had been originally planned to be constructed as an integral part of the Gila Drain channel commencing at the Western Canal and extending southerly along Rural Road and then southwesterly across the Indian Reservation to the Gila River, Tempe is planning to proceed with Phase I as shown. Construction is scheduled for '82-'83 fiscal year and that segment shown as future construction as soon thereafter as development dictates. That segment shown as existing construction consists of retardation structures which permits a slow release of the surface flows easterly along Elliot Road to 56th Street pending construction of the diversion channel.

The former freeway borrow pit designated as "ADOT Borrow Pit" is the key element in this plan. Since the Gila Drain project is an authorized flood control project in the Maricopa County Flood Control District program, the District has attempted to acquire the parcel or obtain a long term lease but has been unsuccessful to date. It is my understanding they currently hold a one year lease renewable annually and we, of course, would not be able to construct the proposed diversion channel without an assured retention/detention area.

GENE SEARS, Vice Mayor
BEVERLY HERMON, Councilman
HARRY E. MITCHELL, Mayor
JAMES R. PHILLIPS, Councilman
WILLIAM J. REAM, Councilman

Although the Freeway contributes a rather minor amount of surface water runoff tributary to the diversion channel, it will be a part of the total conveyed to the borrow pit and we would, therefore, hope that ADOT could find some method of making the pit available for so long as the channel remains operative. Your insight and assistance in helping us find a solution would be deeply appreciated.

Sincerely,

CITY OF TEMPE

Grover Serenbetz, P.E.
Public Works Director

GRS:bn

Enc.

CC: D. Sagramoso
L. Quaas

NICK KARAN

EVANS, KUHN & ASSOCIATES, INC.

GEORGE L. EVANS, P.E.
JOHN D. KUHN, JR., P.E.
MOSES D. MOYA, P.E.
KEITH E. BENNETT, P.E.
FRED L. BAKER, L.S.
DARREL E. WOOD, P.E.

CONSULTING ENGINEERS
727 East Bethany Home Road, Suite 125
Phoenix, Arizona 85014
(602) 241-0782

June 20, 1983
EKA #1950

ADOT PIT DIVERSION CHANNEL
(Gila Drain Phase I)

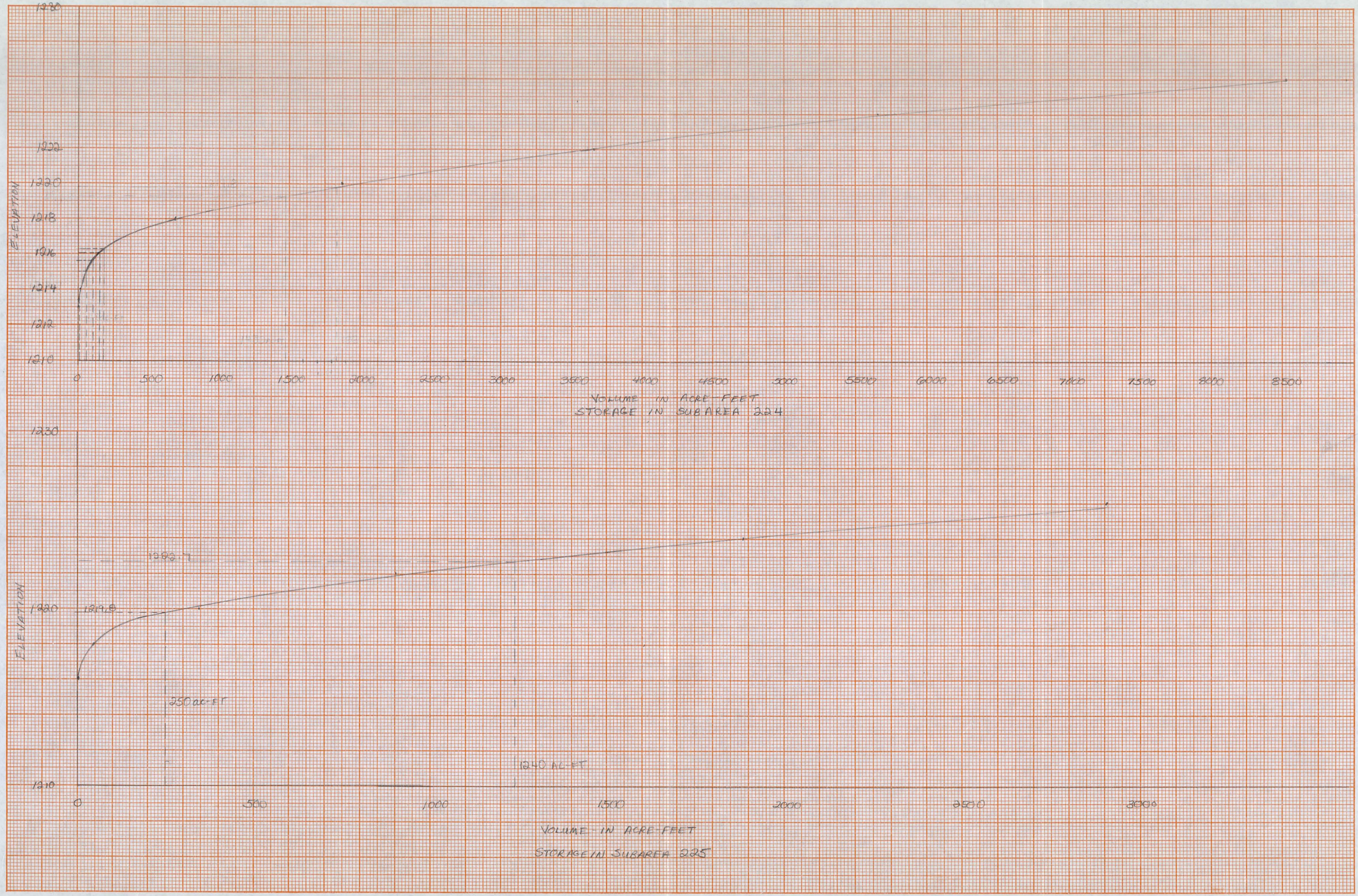
ACRE-FEET OF RUNOFF IN A.D.O.T. PIT*

Return Interval	10yr-2hr	100yr-1hr	50yr-6hr	100yr-24hr
Rainfall Amount	1.75 in.	2.65 in.	2.90 in.	3.85 in.
City of Phoenix	75.0 AcFt 71.0%	170.1 AcFt 67.7%	198.3 AcFt 65.3%	293.1 AcFt 58.3%
Maricopa County	26.0 AcFt 24.6%	72.1 AcFt 28.7%	91.5 AcFt 30.1%	152.5 AcFt 30.3%
City of Tempe	4.7 AcFt 4.4%	9.0 AcFt 3.6%	14.1 AcFt 4.6%	57.5 AcFt 11.4%

*Source: Surface Water Hydrology Report
City of Tempe Project No. 82006
April, 1983

FLOOD CONTROL DISTRICT
RECEIVED
JUL 13 '83

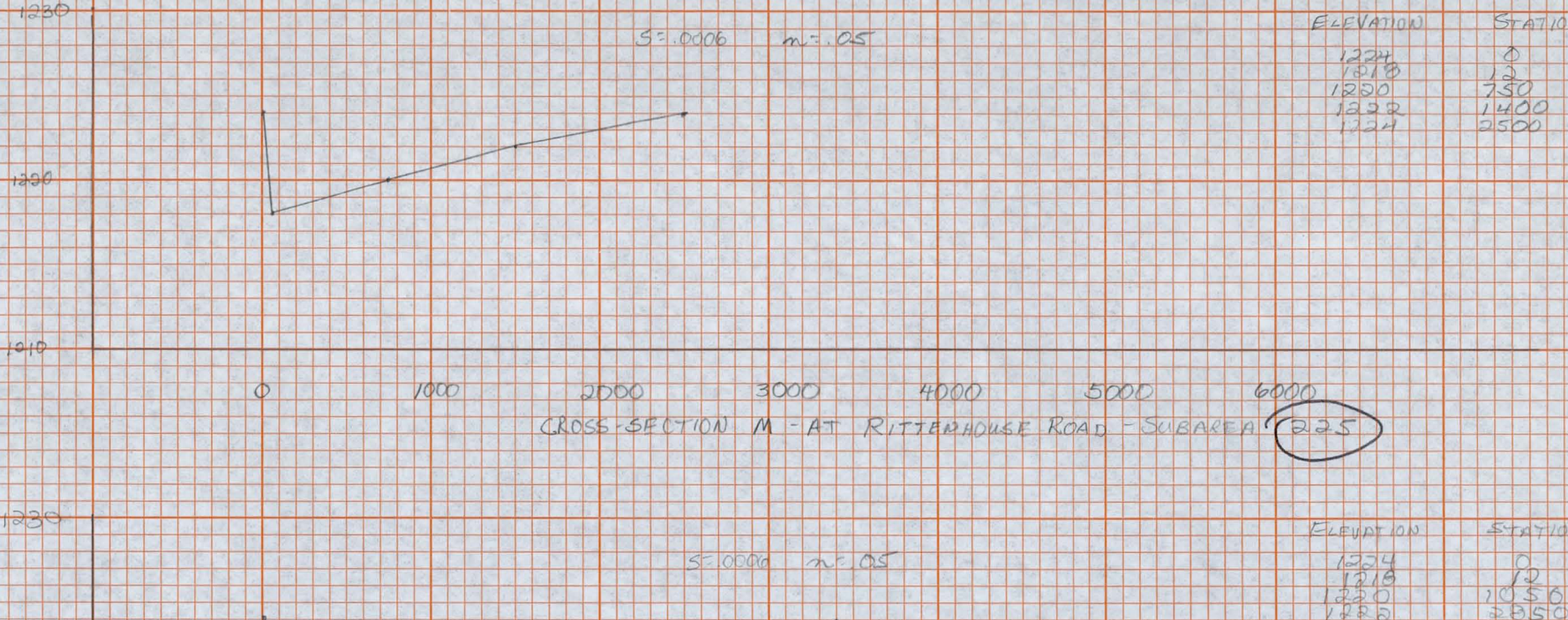
	CH ENG	3	HYDR
	ASST		LMgt
	ADMIN	4	TJL
	C & O		FILE
			DESTROY
	FINANCE	1	SHB
REMARKS			



K+E 10 X 10 TO THE CENTIMETER 47 1513
25 X 38 CM. MADE IN U.S.A.
KEUFFEL & ESSER CO.

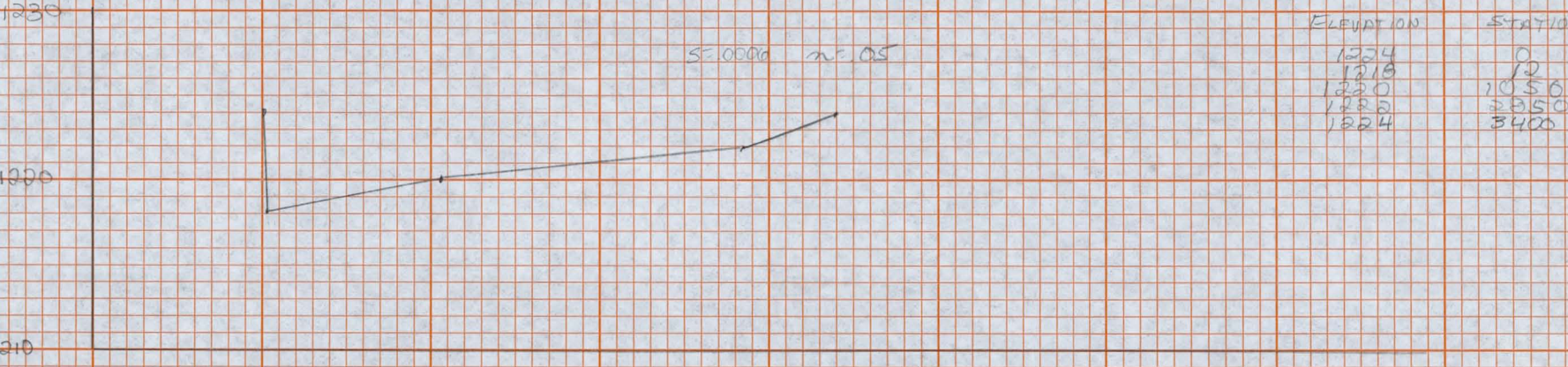
DJG 7/21/75

K+E 10 X 10 TO THE INCH 46 0703
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.



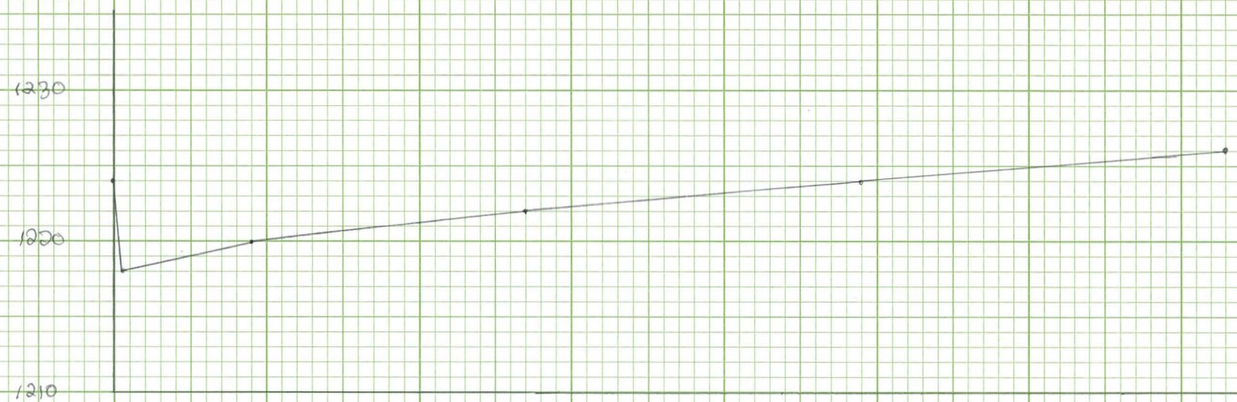
ELEVATION	STATION
1224	0
1218	12
1220	750
1222	1400
1224	2500

CROSS-SECTION M - AT RITTENHOUSE ROAD - SUBAREA 225



ELEVATION	STATION
1224	0
1218	12
1220	1050
1222	2350
1224	3400

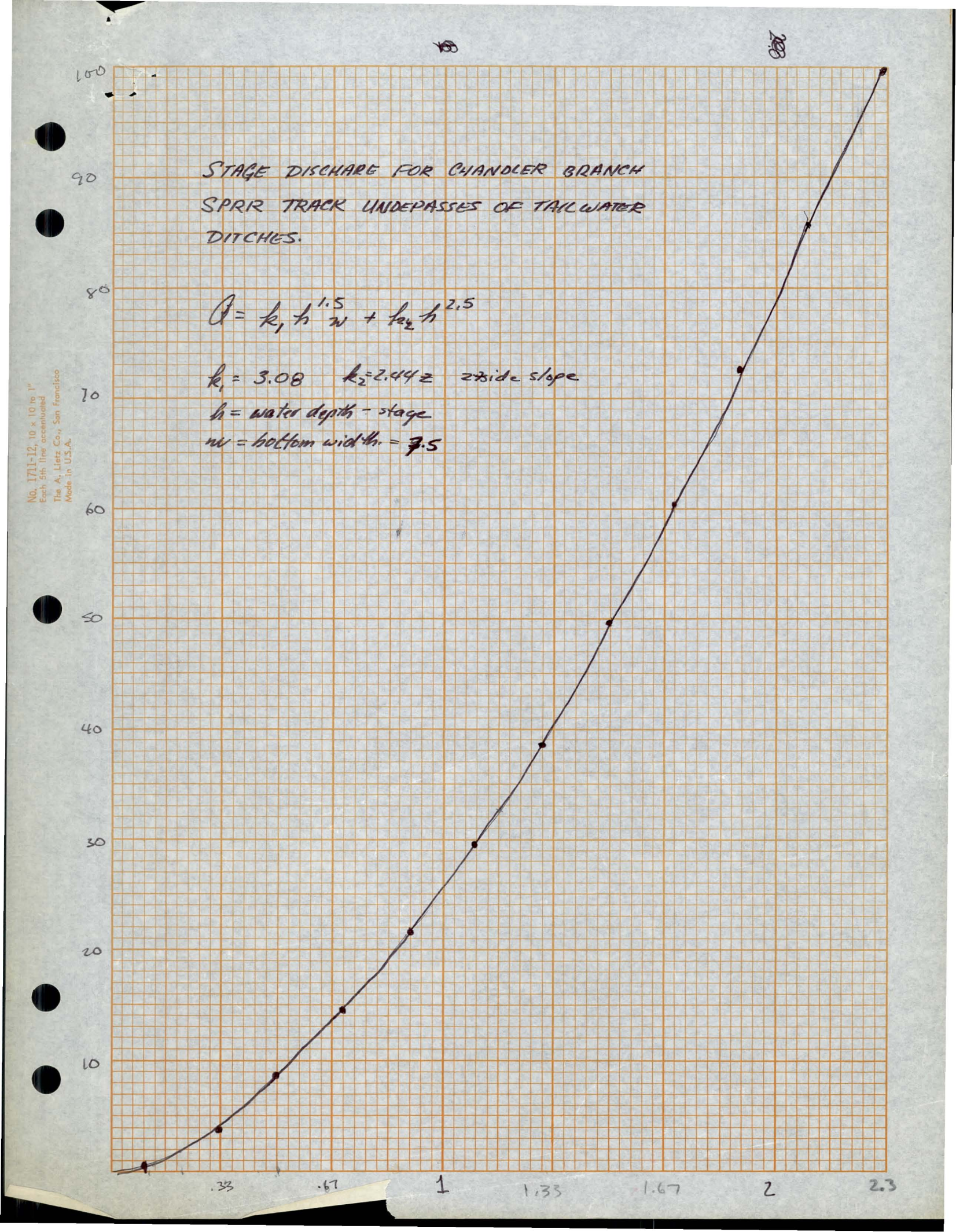
CROSS-SECTION N - AT CITRUS HEIGHTS RD. - SUBAREA 225



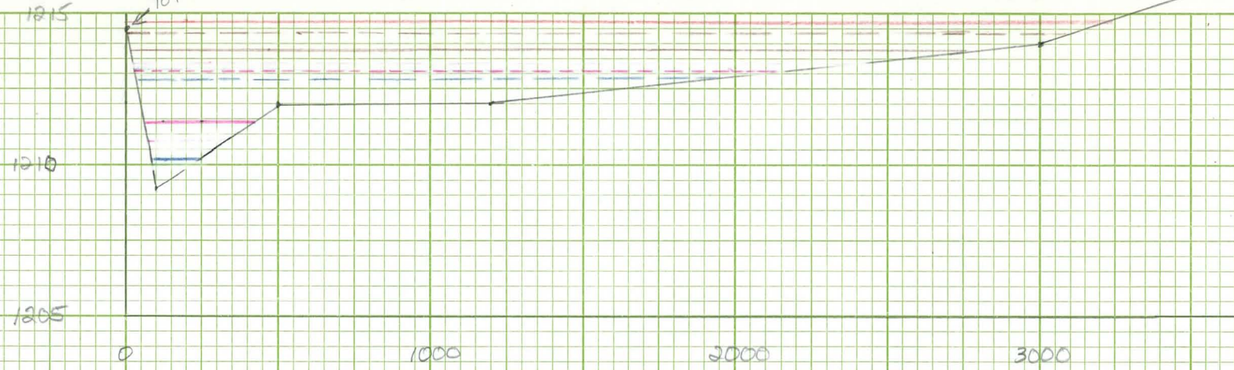
ELEV	STA.
1224	0
1218	12
1220	450
1222	1350
1224	2450
1226	3650

CROSS-SECTION AT SANTAN RD. - Areas 224 & 225

K&E 10 X 10 TO THE INCH 47 0780
10 X 15 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.

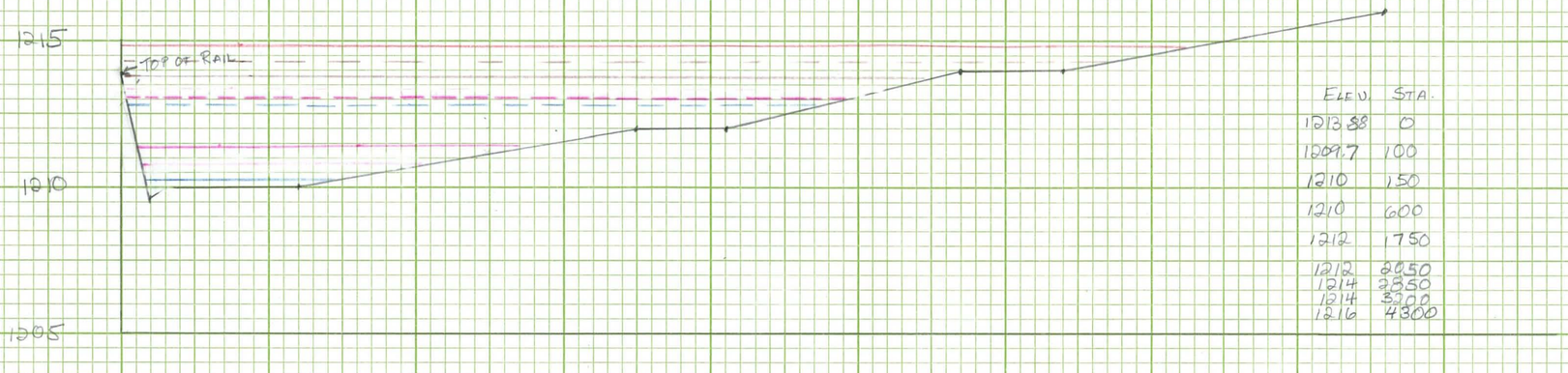


No. 1711-12, 10 x 10 to 1"
Each 5th line accentuated
The A. Lietz Co., San Francisco
Made in U.S.A.



ELEV.	STA
1214.5	0
1209.3	100
1212	500
1212	1200
1214	3000
1216	3600

CROSS-SECTION 1-7 AT MESA DRIVE



ELEV.	STA.
1213.88	0
1209.7	100
1210	150
1210	600
1212	1750
1212	2050
1214	2850
1214	3300
1216	4300

CROSS-SECTION 1-8 - AT BASELINE ROAD

OVERFLOW LEGEND

- S.P.F - PRESENT & FUTURE - ELEV 1214.81
- 100 YEAR - PRESENT - ELEV. 1213.8
- 100 YEAR - FUTURE - ELEV. 1214.13
- * 50 YEAR - PRESENT - ELEV. 1211.4
- * 50 YEAR - FUTURE - ELEV. 1213.05
- * 25 YEAR - PRESENT - ELEV. 1210.2
- * 25 YEAR - FUTURE - ELEV. 1212.78

* REVISED

CROSS-SECTIONS OF PONDING AREA BETWEEN SUPERSTITION FWY AND R.R. LINE TO GILBERT.

K&E 10 X 10 TO THE INCH 47 0780
10 X 15 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.

SUBJECT	DATE	PAGE
GILA FLOODWAY - INUNDATION ANALYSIS	7/18/75	OF PAGES

SOURCE OF DATA: TOPO

COMPUTED BY	CHECKED BY	SECTION
DJG.		INVESTIGATION - SEC A

VOLUME OF STORAGE IN SUBAREA 225

ELEV.	AREA P. UNITS	AREA ACRES
1218	.35	44.8
1220	2.00	256
1222	3.12	399.3
1224	3.80	486.4
1226	4.16	532.4

ELEV.	ΔH	SUR. AREA	AVG. AREA	ΔVOL	TOT. VOL
1216		0			0
	2		22.4	44.8	
1218		44.8			44.8
	2		150.32	300.64	
1220		256			345.44
	2		327.65	655.3	
1222		399.3			1000.74
	2		442.85	885.7	
1224		486.4			1886.44
	2		309.4	1018.8	
1226		532.4			2904.84

ORDINANCE NO. 819.1

PASSED AND ADOPTED BY THE TEMPE CITY COUNCIL ON THE 21st DAY OF April, 1977.

William J. Schiano
MAYOR

ATTEST:
Virginia A. Thompson
CITY CLERK

CITY OF TEMPE

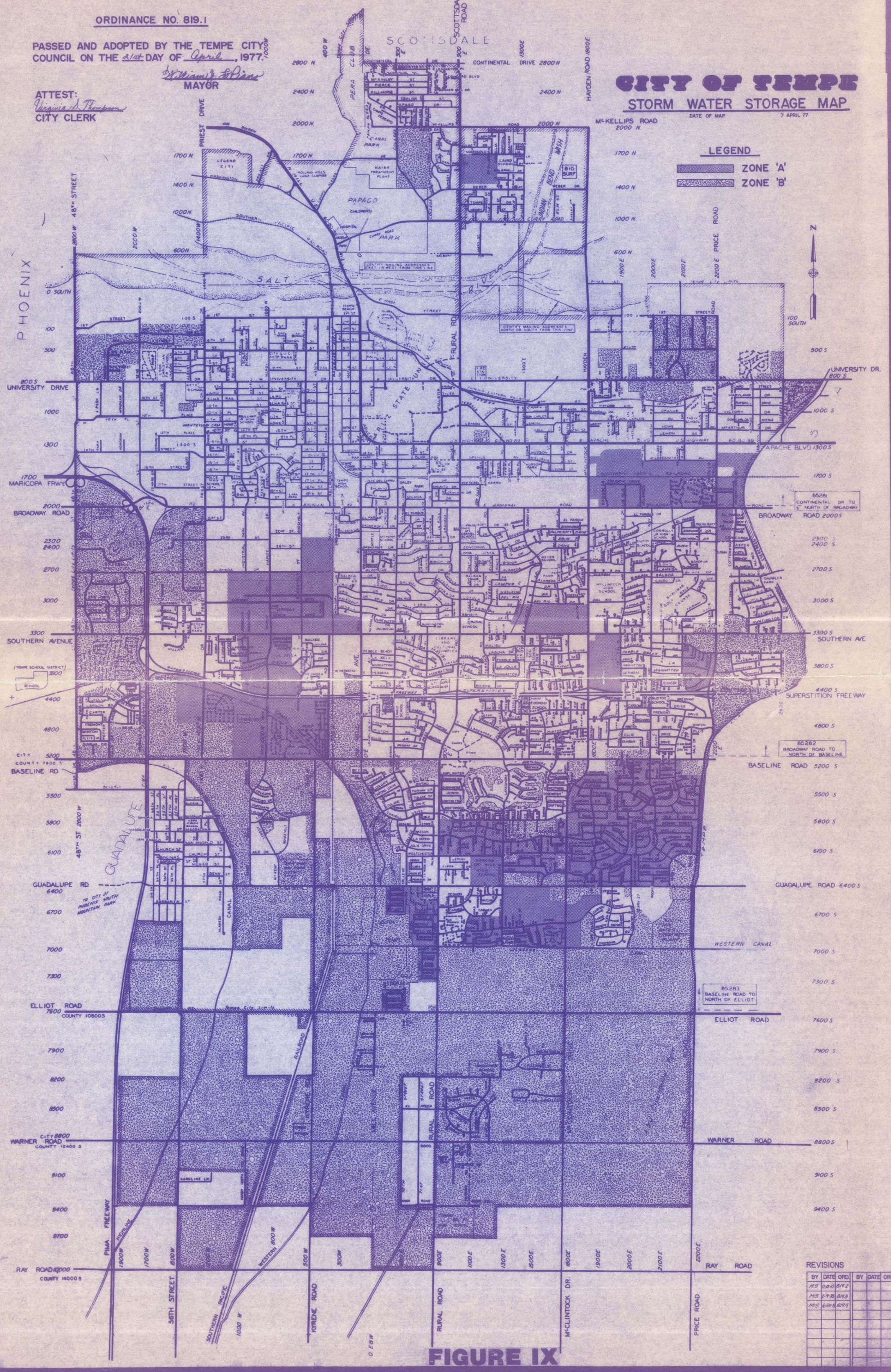
STORM WATER STORAGE MAP

DATE OF MAP 7 APRIL 77

LEGEND

ZONE 'A'

ZONE 'B'



REVISIONS

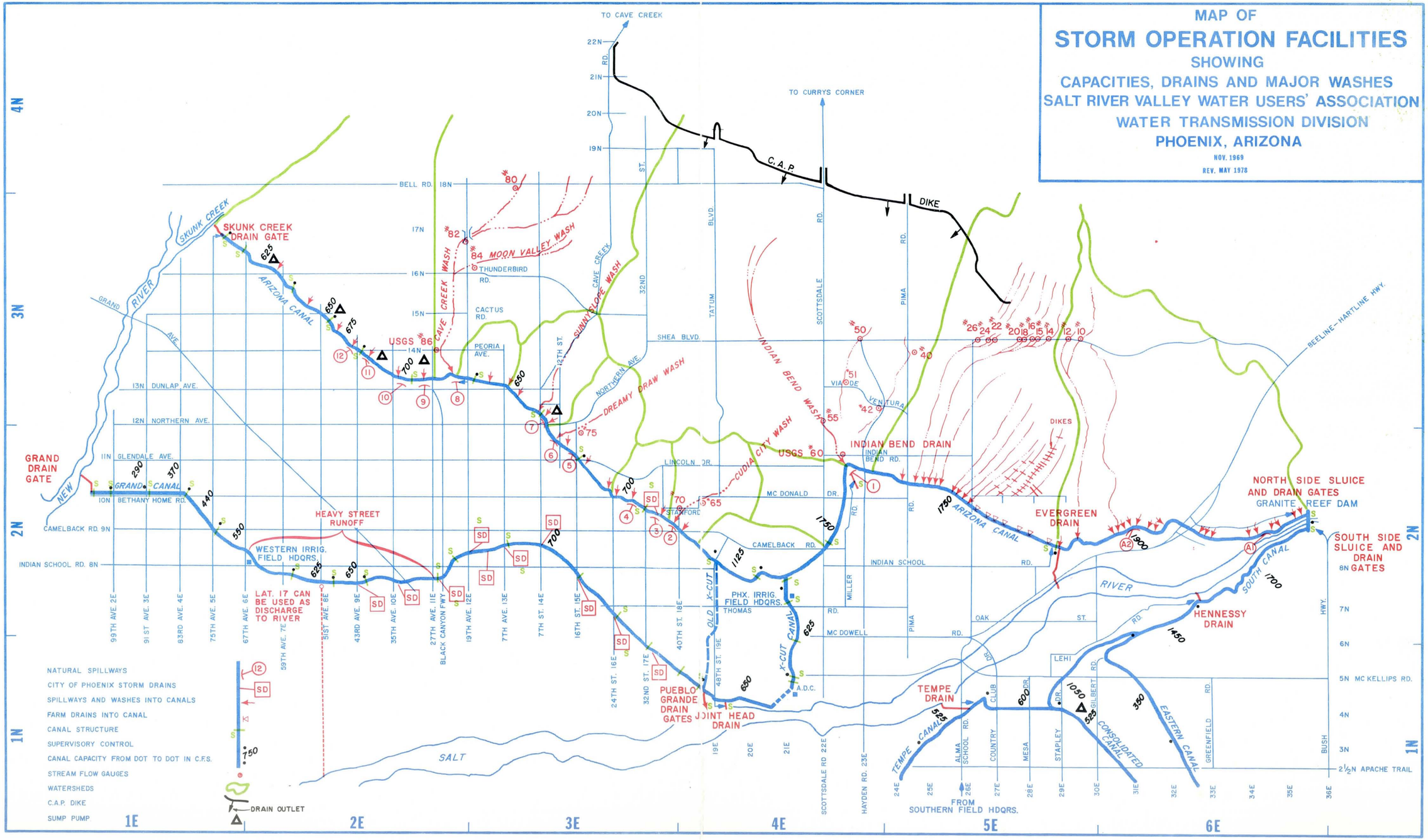
BY	DATE	ORD.	BY	DATE	ORD.
M.S.	11-8-77	819.2			
M.S.	2-9-78	819.3			
M.S.	6-28-78	819.4			

FIGURE IX

Top of 5000 Drawer

MAP OF
STORM OPERATION FACILITIES
SHOWING
CAPACITIES, DRAINS AND MAJOR WASHES
SALT RIVER VALLEY WATER USERS' ASSOCIATION
WATER TRANSMISSION DIVISION
PHOENIX, ARIZONA

NOV. 1969
REV. MAY 1978



HDR Engineering, Inc.
October 26, 1992

Summary of Santan Channel/Gila Drain Outfall Construction Option 3

General Project Description: A new concrete-lined storm water collector channel along the north side of the future Santan Freeway beginning at Price Road, 1000 feet north of Pecos Road, proceeding westerly along ADOT R.O.W. to an intersection with the existing Gila Drain irrigation ditch (to be diverted into conduit), then following the Gila Drain alignment southwesterly (Gila Drain Outfall) to Maricopa Road where a new crossing of Maricopa Road shall be constructed approximately 300 feet north of the existing crossing. This improved channel will discharge approximately 1800 cfs into a proposed Gila Drain Floodway located on Gila River Indian Community land, with an ultimate discharge downstream into the Gila River. The project will also include a new concrete lined channel beginning at 56th St. and continuing easterly to the Santan Collector/Gila Drain intersection. See sketch attached.

Option 3 Description

A. R.O.W. available to be used. (R.O.W. maps are included in this material.) Unacquired sections of R.O.W. at the east end of the project may or may not be acquired. The Hearthstone Subdivision area is assumed not to have been acquired.

B. Channels to be constructed to ultimate planned alignment and grade where ADOT R.O.W. is available. An interim earth channel is planned adjacent to Pecos Road from McClintock Dr. to 1/2 mile east of McClintock Dr. A drainage easement may be required through this area.

C. Crossing structures on the Gila Drain outfall portion to be constructed and street pavement or railroad trackage reinstalled. Santan Collector crossings are to be left as open cut.

D. Throwaway costs include the excavation of the Hearthstone bypass channel and the drainage easement expense.

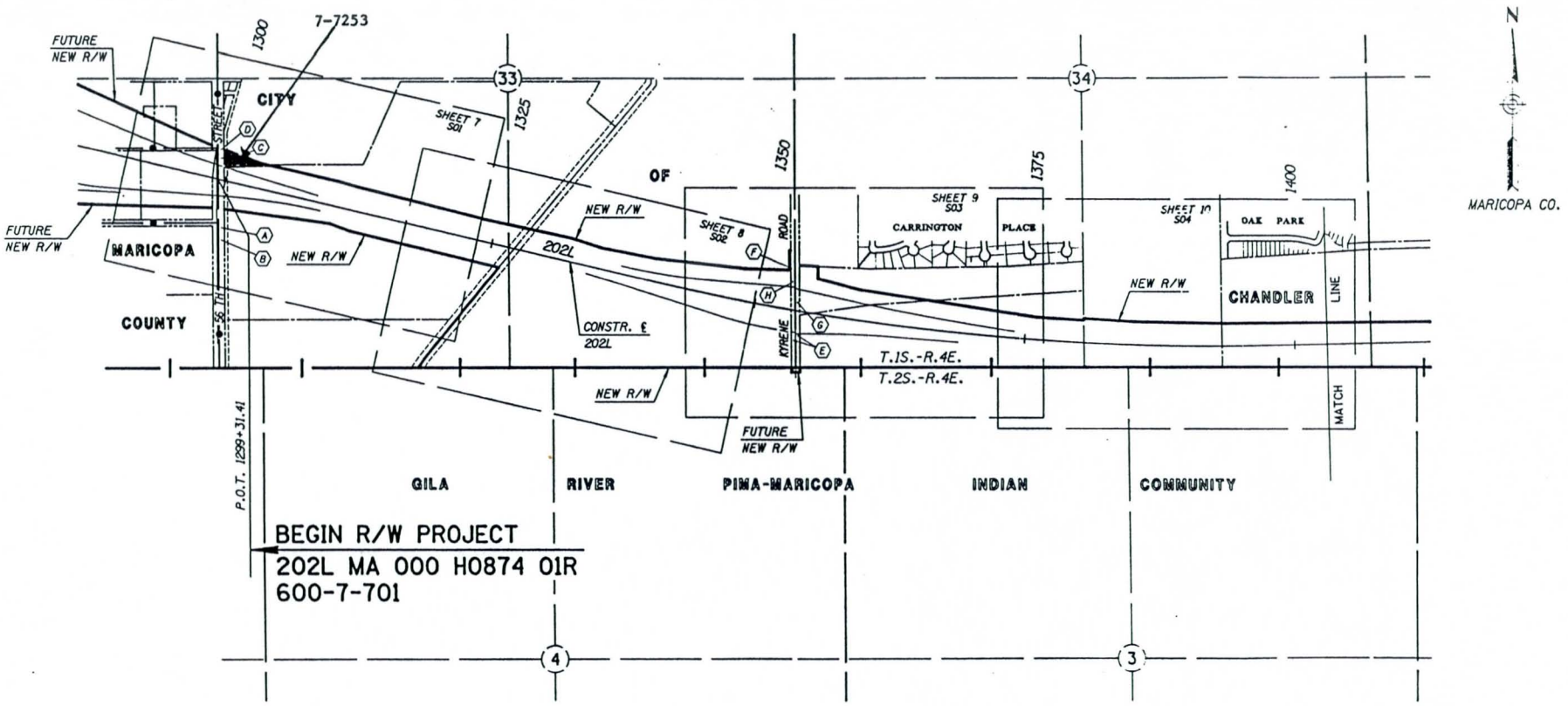
E. Cost Summary

	Construction Costs	Drg. Esmt. Acquisition	Floodway Excav.**	Total Proj. Costs	[Throwaway Costs]
Option 3	$8,817,050	$198,000*	$3,840,000	**$12,855,050**	[$666,750]

A detailed cost estimate is attached.

*Estimated cost of 2640' long, 100' wide drainage easement at $0.75 per square foot (approx. one-half of estimated market value).

**Based upon 1.2 million cubic yards at $3.20 per cubic yard of excavation. Subject to variance.



VICINITY MAP
SCALE 1" = 500'

THIS DRAWING IS PRESENTED BY HDR AS AN ILLUSTRATION ONLY FOR THE SANTAN COLLECTOR/GILA DRAIN OUTFALL CONSTRUCTION OPTIONS. SHADED AREAS REPRESENT REMAINING RIGHTS-OF-WAY TO BE ACQUIRED BETWEEN 56TH ST AND PRICE ROAD. 9-29-92

REVISIONS			
C.O. NO.	DATE	BY	DESCRIPTION
8402	09/26/91	CRD	REVISED NORTH R/W LINE PAR. 7-7125
8482	3/4/92	CRD	CHANGED SHEET NUMBERS
8500	4/15/92	CRD	REVISED NORTH R/W LINE PAR. 7-7126

DRAWING NO. D-7-T-866
HARD COPY
DRAWN/DATE C. DYSON 6/91
CHECKED/DATE J. TRUJILLO 6/91
KEITH W. HUBBARD PROFESSIONAL ENGINEER
ROUTE 202L
LOCATION I-10 - PRICE ROAD

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
RIGHT OF WAY PLANS SERVICES
HIGHWAY SANTAN FREEWAY
PROJECT NO. 600-7-701

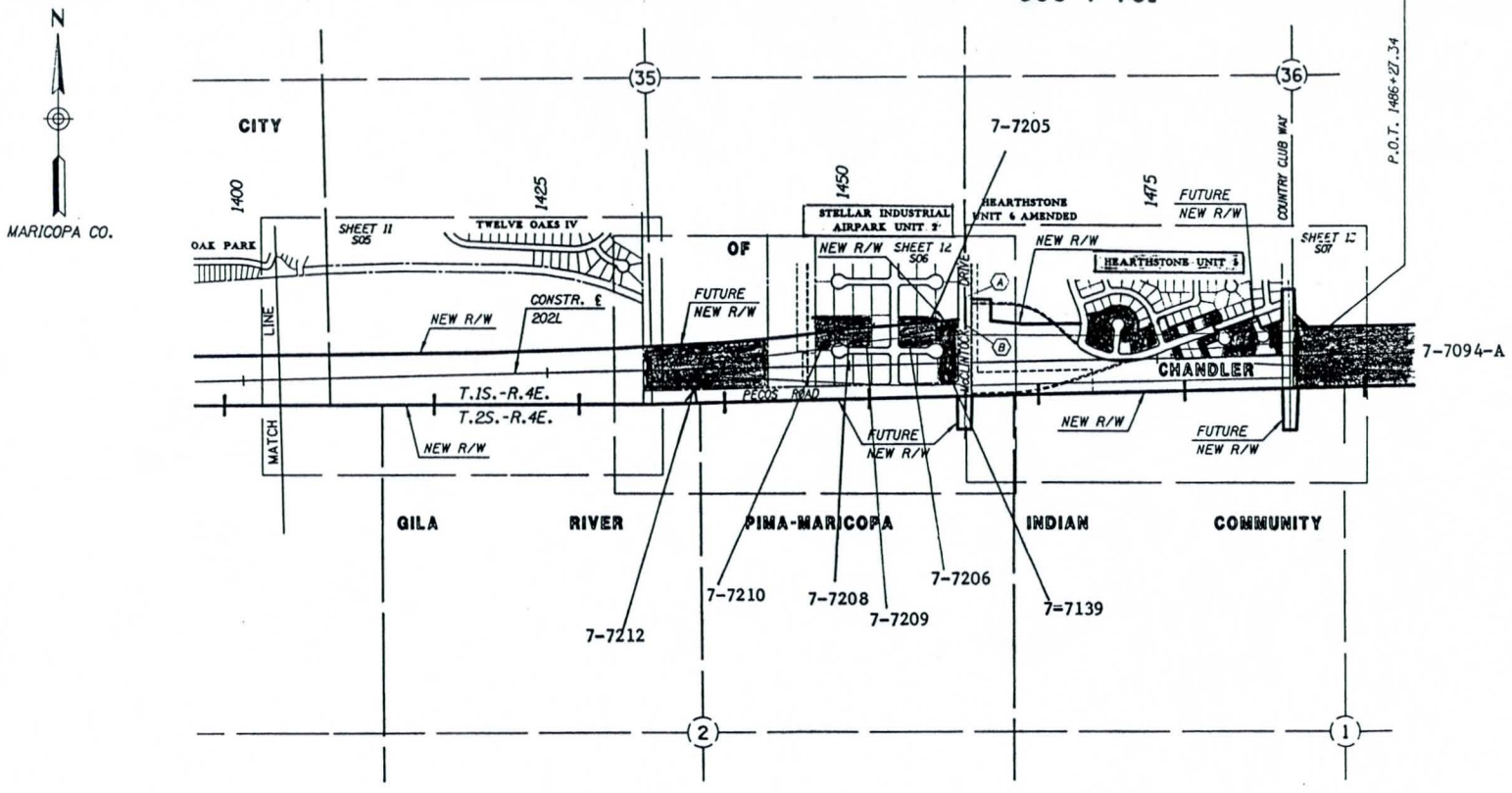
SHEET 5 OF 21

TRACS NO. 202L MA 000 H0874 01R

OF

END R/W PROJECT
202L MA 000 H0874 01R
600-7-701

BEGIN R/W PROJECT
101L MA 59 H2222 03R
D-7-T-864



VICINITY MAP
SCALE 1" = 500'

THIS DRAWING IS PRESENTED BY HDR AS AN ILLUSTRATION ONLY FOR THE SANTAN COLLECTOR/GILA DRAIN OUTFALL CONSTRUCTION OPTIONS. SHADED AREAS REPRESENT REMAINING RIGHTS-OF-WAY TO BE ACQUIRED BETWEEN 56TH ST AND PRICE ROAD. 9-29-92

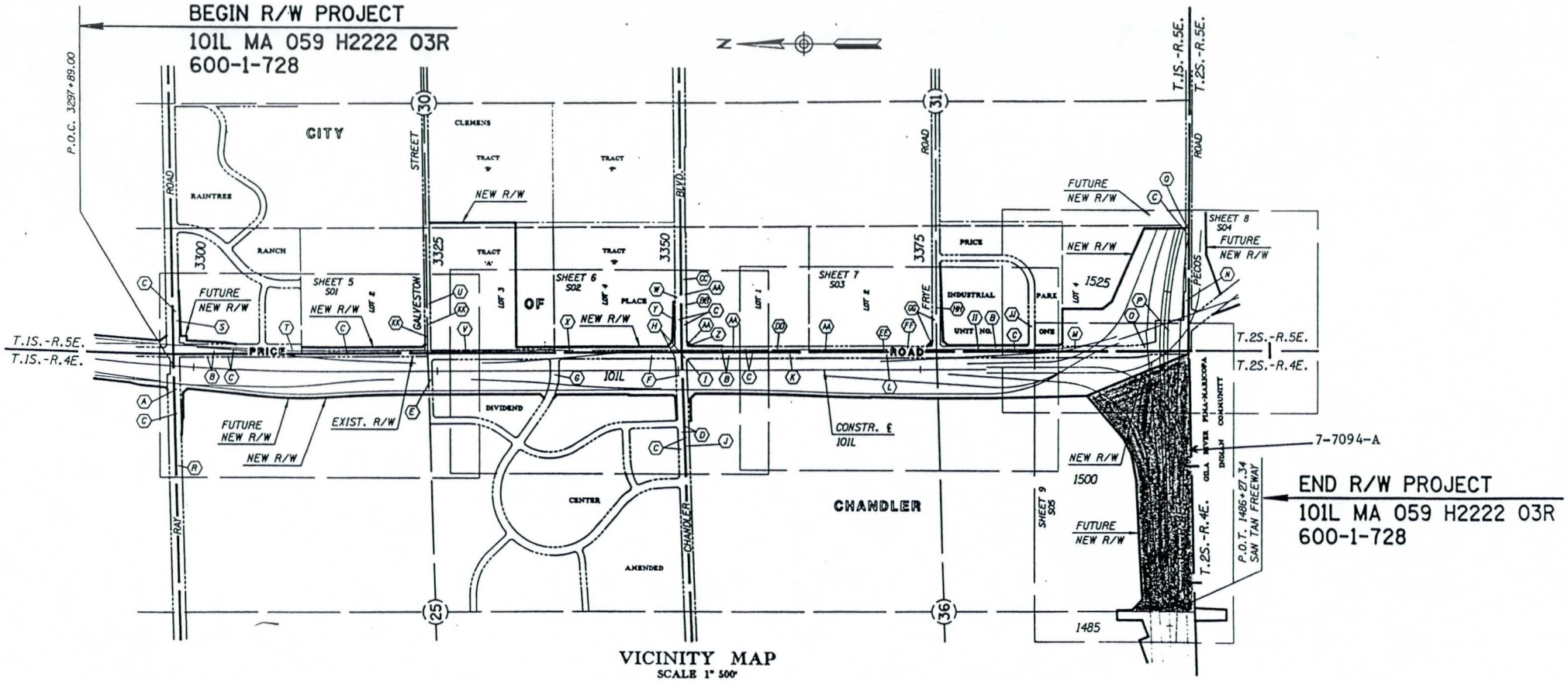
REVISIONS			
C.O. NO.	DATE	BY	DESCRIPTION
8402	09/26/91	CRD	REVISE NORTH R/W LINE SE 1/4 SEC. 35
8482	3/4/92	CRD	CHANGED SHEET NUMBERS

DRAWING NO. D-7-T-866
HARD COPY
DRAWN/DATE C. DYSON 6/91
CHECKED/DATE J. TRUJILLO 6/91
KEITH W. HUBBARD
PROFESSIONAL ENGINEER

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
RIGHT OF WAY PLANS SERVICES
HIGHWAY: SANTAN FREEWAY
PROJECT NO.: 600-7-701
ROUTE: 202L
LOCATION: I-10 - PRICE ROAD
SHEET 6 OF 21

TRACS NO. 202L MA 000 H0874 01R

OF



VICINITY MAP
SCALE 1" 500'

THIS DRAWING IS PRESENTED BY HDR AS AN ILLUSTRATION ONLY FOR THE SANTAN COLLECTOR/GILA DRAIN OUTFALL CONSTRUCTION OPTIONS. SHADED AREAS REPRESENT REMAINING RIGHTS-OF-WAY TO BE ACQUIRED BETWEEN 56TH ST AND PRICE ROAD. 9-29-92

REVISIONS			
C.O. NO.	DATE	BY	DESCRIPTION
8439	2-26-92	KWH	ADDED (KK) AND ALTERED VICINITY MAP

DRAWING NO.	D-7-T-864
HARD COPY	
DRAWN/DATE	C. DYSON 1/92
CHECKED/DATE	J. TRUJILLO 1/92
KEITH W. HUBBARD PROFESSIONAL ENGINEER	
ROUTE	S.R. 101L
LOCATION	RAY ROAD - PECOS ROAD

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
RIGHT OF WAY PLANS SERVICES
PRICE ROAD FREEWAY
600-1-728

TRACS NO. 101L MA 059 H2222 03R

CLIENT	Arizona Department of Transportation		JOB NO.	173-39-44	Estimate for Santan Collector System	
PROJECT	Price Expressway		ESTIMATED	ETL	From I-10/Maricopa Rd. TI to Price/	
SECTION	Santan Collector/Gila Drain System		CHECKED	JZ	Santan TI	
STATIONS			DATE	02-92	OPTION 3	
LENGTH	29,500 feet		REVISED	4-06-92 : 10-23-92		fn=Collect3

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
	Includes: Partial ROW Acquisition Assumed				
	Incomplete Gila Drain and Santan Collector				
	Earth Channel from 1458+16				
	thru Hearthstone to 1487+16				
	Structures at Maricopa Rd., I-10, Price Rd.				
	Allison St., SPRR Only				
	Utility Relocation as Necessary Only				
	Cross Street Repaving at Maricopa Rd, I-10,				
	Allison St., SPRR (rebuild trackage)				
	Does not include:				
	Structures at Kyrene, Country				
	Club, McClintock, Santan				
1	Concrete Channel Lining				
	Gila Drain improvement, L=7395'	43,346	SY	$18	$780,228
	1299+80 - 1327+00	15,436	SY	$18	$277,848
	1327+00 - 1352+41	19,700	SY	$18	$354,600
	1354+04 - 1458+64	58,423	SY	$18	$1,051,614
	1487+16 - siphon	11,306	SY	$18	$203,508
2	Drainage Excavation				
	Gila Drain improvement, L=7395'	59,500	CY	$3	$178,500
	1299+80 - 1327+00	22,328	CY	$3	$66,984
	1327+00 - 1352+41	37,678	CY	$3	$113,034
	1354+04 - 1458+64	131,244	CY	$3	$393,732
	1458+64 - 1487+16	156,250	CY	$3	$468,750
	1487+16 - siphon	45,933	CY	$3	$137,799
3	Structural Excavation				
	1327+05 Santan X-ing	7,467	CY	$3	$22,401
	1352+41 - 1354+04 Kyrene X-ing	2,350	CY	$3	$7,050
	1458+64 - 1460+31 McClintock X-ing	2,250	CY	$3	$6,750
	2-8'x8' Siphon at Price/Santan TI	4,200	CY	$4	$16,800
	Maricopa Road	4,091	CY	$4	$16,364
	I-10	3,882	CY	$4	$15,528
	Ramp DE	3,481	CY	$4	$13,924
	Allison St.	1,518	CY	$4	$6,072
	SPRR	1,518	CY	$4	$6,072
4	Structures				
	4-10x6 Box Culvert Allison St.	110	LF	$868	$95,480
	4-10x6 Box Culvert SPRR	110	LF	$868	$95,480
	4-10x7 Box Culvert Maricopa Rd.	235	LF	$875	$205,625
	4-10x7 Box Culvert I-10	1	LS	$200,714	$200,714

Continued next page

Option 3

	60-inch RCP (75cfs irrigation)	9,230	LF	$135	$1,246,050
	2-8'x8' Box Culvert Siphon	350	LF	$394	$137,900
5	Rebuild Pavement/Crossing (incl. removal)				
	Maricopa Road (AC)	667	SY	$14	$9,338
	I-10 (AC)	1,389	SY	$14	$19,446
	Allison St. (AC)	444	SY	$14	$6,216
	SPRR	1	LS	$10,000	$10,000
6	Basin B				
	Excavation	360,000	CY	$1.5	$540,000
	Weir, conc. lined, L=500'	778	SY	$18	$14,004
	36-inch RCP (Basin B drain)	200	LF	$68	$13,600
7	Utility Relocation	1	LS	$114,125	$114,125
		SUB-TOTAL A			$6,845,536
	Other Misc. Items:	(15 % of Sub-Total A)			$1,026,830
		SUB-TOTAL B			$7,872,366
	Contingency & Engineering:	(12% of Sub-Total B)			$944,684
		Estimated Construction Total			$8,817,050
8	Floodway Excavation	1,200,000	CY	$3.20	$3,840,000
9	Drainage Easement Acquisition	264,000	SF	$0.75	$198,000
		Total Project Costs			$12,855,050

GILA DRAIN OUTFALL INTERIM PROJECT

PROPOSED SANTAN CHANNEL -

GILA DRAIN

S. MTN. FREEWAY

SANTAN FREEWAY

BASIN B

PROPOSED GILA DRAIN OUTFALL
(ALONG EXISTING GILA DRAIN ALIGNMENT)

PROPOSED INTERIM CHANNEL
(AROUND HEARTHSTONE SUBDIVISION)

2-8'X8' RCB SIPHON

4-10'X6' RCB

4-10'X7' RCB

4-10'X7' RCB

EXCAVATED AREA

GILA DRAIN FLOODWAY

PHASE I
REQUIRED BY AGREEMENT
BETWEEN ADOT AND GRIC

TO 24TH STREET

NO STRUCTURE ★

NO STRUCTURE ★

NO STRUCTURE ★

NO STRUCTURE ★

★ STRUCTURE NOT INCLUDED IN INTERIM PROJECT

SANTAN CHANNEL

PHOENIX

CHANDLER

West Chandler

Hightown

STELLAR AIRPARK

Firebird Lake

INTERCHANGE 160

INTERCHANGE 162

Water Tank

Kyrene Gin

Loading Pens

Landing Strip

PECOS RD.

CHANDLER

WILLIAMS FIELD ROAD

RAY ROAD

ALLISON ST.

SPRR

HIGHLINE CANAL

KYRENE ROAD

MC CLINTOCK DRIVE

PRICE ROAD

MARICOPA RD.

I-10

GILA RIVER

10-92

HDR

HDR Engineering, Inc.

GILA DRAIN PROJECT

PHOENIX – CASA GRANDE HWY SECTIONS

COOLIDGE - MESA HWY. SECTIONS

COOLIDGE – MESA HWY.
Dock – Maricopa County Line
Pinal County

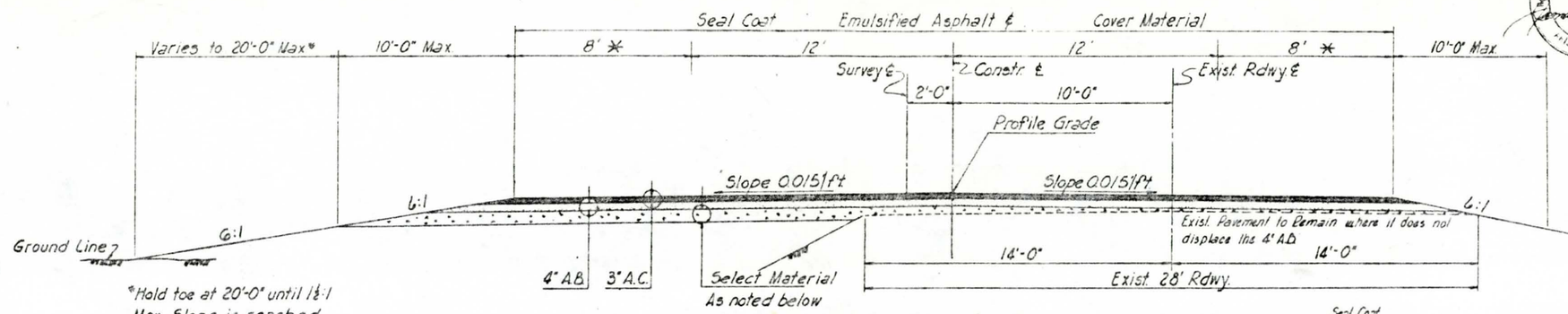
* See Spec. Provisions for Shoulder Demarcation.

DIST. REGION	STATE	PROJECT NO	SHEET NO	TOTAL SHEETS	AS BUILT
7	ARIZ	F-021-1(7)	2	22	Marked 5-29-64

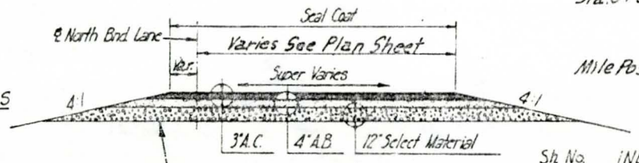
JAMES M. SAMER — REGISTERED PROFESSIONAL ENGINEER — ARIZONA U.S.A.

L.H. BELL & ASSOCIATES
11-10-61 DATE

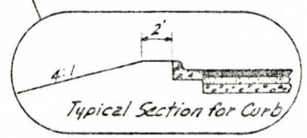
DESIGNED BY A.L.	DRAWN BY R.D.	CHECKED BY R.G.



TYPICAL SECTION



TYPICAL SECTION
INTERSECTION AREA



SELECT MATERIAL THICKNESS

Sta.	to Sta.	Inches
0+00	130+00	6"
130+00	8+01.43	12"

LENGTH OF PROJECT

Sta 0+00 to Sta 41+10.28 Bk. =	4,110.28
Sta 41+08.64 Ahd to Sta 52+18.64 Bk. =	1,110.00
Sta 52+18.56 Ahd. to Sta 203+37.46 Bk. =	15,118.90
Sta 203+37.36 Ahd. to Sta 212+75.01 Bk. =	937.65
Sta 212+75.12 Ahd to Sta 248+80.67 Bk. =	3,605.55
Sta 248+80.78 Ahd. to Sta 258+46.84 Bk. =	966.06
Sta 258+46.73 Ahd to Sta 338+78.18 Bk. =	8,031.45
Sta 338+74.88 Ahd to Sta 386+43.058K. =	4,768.17
Sta. 0+00 Ahd. to Sta. 8+01.43 =	801.43
Total =	39,449.49
Gross Length =	7.471 Miles

Mile Post 152.19 to Mile Post 159.66

INDEX OF SHEETS

Sh. No.	
1.	Face Sheet
2.	Summary Sheet (This Sheet)
3	Structure Summary Sheet
4-17	Plan and Profile
18.	Intersection Geometrics
19	Intersection Profiles
20	Traffic Sheet
21	Location & Spec. Details Sta's 42+, 54+, 81+, 90+, 116+, 148+, 183+, 218+, 250+, 268+, 282+ & 328+.
22	Location & Spec. Details Sta's 6+, 14+, 29+ & 308

ROADWAY STANDARDS-1959

C-1	C-8-2	C-16	C-33-1
C-2	C-9-A	C-16-A	C-38
C-3	C-13	C-20	C-43
C-4	C-14	C-23-A	
C-7-1			

NEW PIPE CULVERT

Sta.	Size	Corr. Metal Length	Gauge	Reinf. Conc. Installation	Bedding	Class	Remarks
3+00	24"	70'	14	Type 1	C	III	
16+88 Rt. 17+20	24"	24'	14	Type 1	C	III	
Lt. 75+00	"	70'	"	"	"	"	
Rt. 76+00	"	70'	"	"	"	"	
Lt. 83+10	"	70'	"	"	"	"	
Lt. 112+50	"	70'	"	"	"	"	
Rt. 113+45	"	50'	"	"	"	"	
Lt. 157+60	"	70'	"	"	"	"	
Lt. 207+50	"	~~50'~~ 70'	"	"	"	"	
Rt. 335+95	"	50'	"	"	"	"	
Lt. 112+00	18"	32'	"	"	"	"	Hdwl. Lt & Rt Std C-9-A

NEW REINF. CONC. PIPE WITH RUBBER GASKETED JOINTS

Sta.	Size	Length	Installation	Bedding	Class	Remarks
64+60	30"	~~144'~~ 154'	Type 1	C	III	Straight Hdwl. Rt. Std C-9
Lt. 64+60	18"	12'	"	"	"	Headgate Pt (Salvaged) Str. Hdwl.
Lt. 73+90	24"	40'	"	"	"	Spec. Wing Hdwls. Rt & Lt.
Lt. 74+40	30"	40'	"	"	"	" " " " "
Lt. 81+00	30"	54'	"	"	"	Syphon, Spec. Wing Hdwls, Rt & Lt.
Lt. 81+75	24"	10'	"	"	"	Headgate Pt (Salvaged) Str. Hdwl.
Lt. 83+90.77	30"	~~48'~~ 48	"	"	"	Spec. Wing Hdwls. Rt & Lt.
Lt. 84+20	18"	10'	"	"	"	Headgate Pt (Salvaged) Str. Hdwl.
Lt. 94+20	18"	10'	"	"	"	" " " " " "
Lt. 103+20	18"	10'	"	"	"	" " " " " "
Lt. 138+95	18"	12'	"	"	"	" " " " " "
Lt. 148+90	24"	70'	"	"	"	Str. Hdwl.
Lt. 149+00	24"	76'	"	"	"	Syphon, Spec. Wing Hdwls, Rt & Lt.
Lt. 150+10	24"	12'	"	"	"	Headgate Pt (Salvaged) Str. Hdwl.
Lt. 158+12	24"	50'	"	"	"	Spec. Wing Hdwls. Rt & Lt.
Lt. 158+40	18"	50'	"	"	"	Hdwl.
Lt. 158+~~93~~ 30	24"	12'	"	"	"	Headgate Pt (Salvaged) Str. Hdwl.
Lt. 186+50	18"	12'	"	"	"	" " " " " "

NEW CORR. METAL PIPE

Sta.	Size	Length	Gauge	Remarks
307+40	24"	16'	14	Ext. 16' Lt, Straight Hdwl Lt, Std C-9

75.887 ~~96.498~~ FENCE & GATES
Lin. Ft 4 Wire fence Req'd. Std C-16
8 No 1 Gates Req'd Std. C-16

215.3 ~~17.2~~ C.Y. PIPEAP
Std C-23-A Type "A"

GUIDE POSTS
40 Req'd. Std C-8-2 "BP"

RIW MARKERS
51 Req'd Std C-1

CATTLE GUARDS

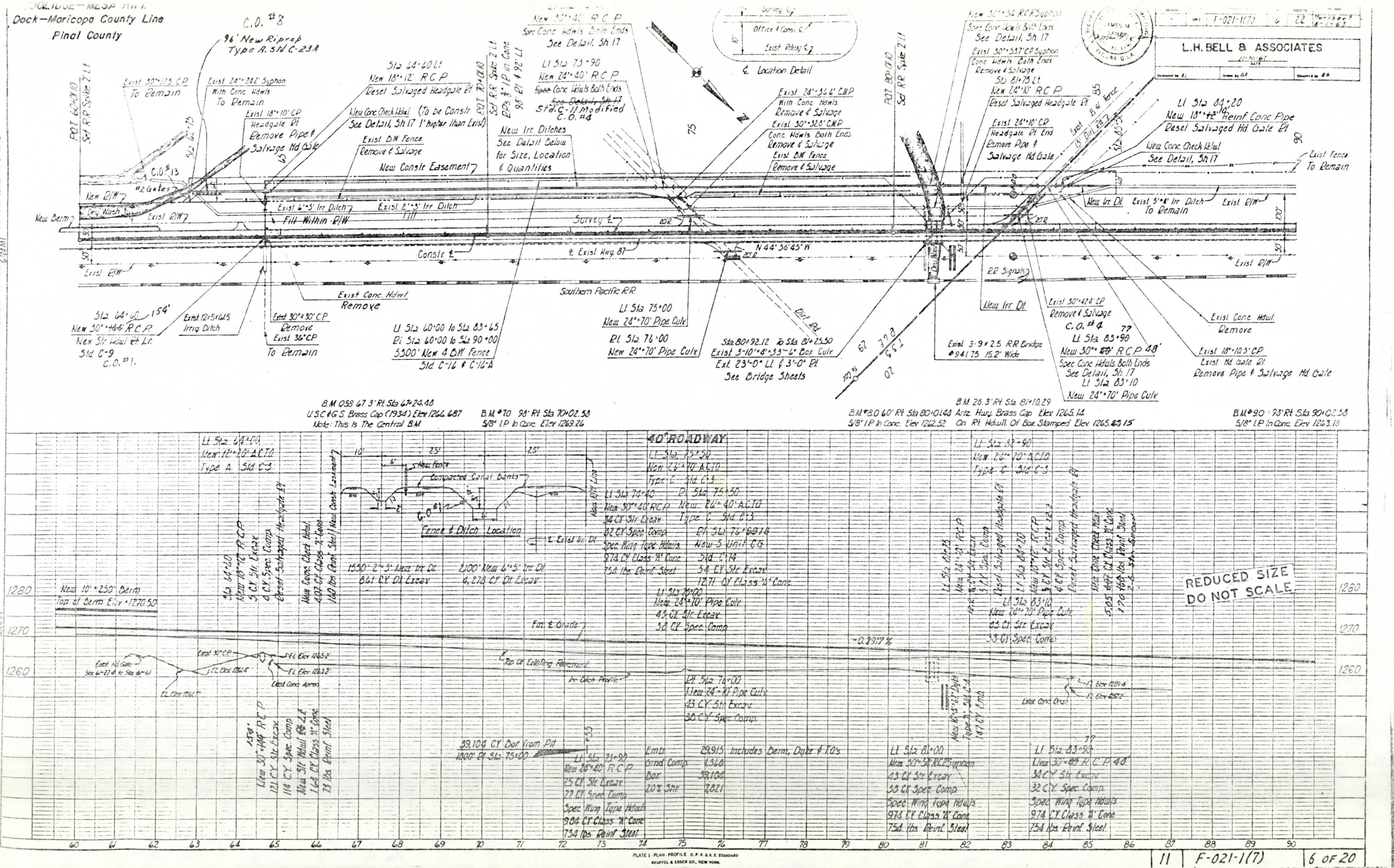
3 Units	Std. C-14	Rt Sta 5+10
5 Units	"	Rt Sta 76+10
4 Units	"	Rt Sta 113+60
6 Units	"	Rt Sta 187+50
4 Units	"	Lt Sta 207+70

SINGLE CONC. CURB
~~1320~~ 1342 Lin. Ft. Type "A" Std. C-20 h = 7"

Notes:
The existing Irrigation System shall be left intact until all changes have been completed. All replacement structures shall be as detailed, otherwise the same dimensions and design as the originals, in the same relative location and at the same elevations.

REDUCED SIZE DO NOT SCALE.

GENERAL NOTES
All R/W provisions shall be complied with before job acceptance.
R/W encroachments shall be removed by order of the State unless otherwise noted.
R/W Markers will be furnished and placed by the Contractor as directed by the Engr. Std. C-1.
Proj. Markers will be furnished by the State and placed by the Engr. Std. C-38.
Bench Markers will be furnished by the State and placed by the Contractor. Std. C-38.
Mile Post Markers will be furnished by the State and placed by the Engr. Std C-8-2.
Utilities disturbed by new construction shall be reset or replaced by the interested utility.
Natural growth outside of staked areas shall not be disturbed.
Striping of finished Rdwy. shall be for Standard 2 lane operation.


COOLIDGE–MESA HWY.
Dock–Maricopa County Line
Pinal County
L.H. BELL & ASSOCIATES
F-021-1(7)
C.O. #8
96' New Riprap Type A Std C-23A
Exist 30"x175' CP To Remain
Exist 24"x242' Syphon With Conc Hdwls To Remain
Exist 18"x10' CP Headgate Rt Remove Pipe & Salvage Hd Gate
Sta 64+60 Lt New 18"x12' RCP Reset Salvaged Headgate Rt
New Conc Check Hdwl (To be Constr 1' higher than Exist) See Detail, Sh 17
New 30"x40' RCP Spec Conc Hdwls Both Ends See Detail, Sh 17
Lt Sta 73+90 New 24"x40' RCP Spec Conc Hdwls Both Ends
Std C-11 Modified C.O. #4
New Irr Ditches See Detail Below for Size, Location & Quantities
Exist D/W Fence Remove & Salvage
New Constr Easement
Exist 24"x34' CMP With Conc Hdwls Remove & Salvage
Exist 30"x32.0' CMP Conc Hdwls Both Ends Remove & Salvage
Exist BW Fence Remove & Salvage
Survey ¢
Office & Constr ¢
Exist Rdwy ¢
¢ Location Detail
New 30"x34' RCP Syphon Spec Conc Hdwls Both Ends See Detail, Sh 17
Exist 30"x53.7' CP Syphon Conc Hdwls Both Ends Remove & Salvage
Sta 81+75 Lt New 24"x10' RCP Reset Salvaged Headgate Rt
Exist 24"x10' CP Headgate Rt End Remove Pipe & Salvage Hd Gate
Lt Sta 84+20 New 18"x10' Reinf Conc Pipe Reset Salvaged Hd Gate Rt
New Conc Check Hdwl See Detail, Sh 17
Exist Fence To Remain
New R/W
Dry Wash
#2 Gates
C.O. #13
Exist R/W
New Berm
Exist 6"x5' Irr Ditch Fill Within R/W
Exist 2"x3' Irr Ditch Fill
Constr ¢
¢ Exist Hwy 87
N 44°56'45" W
Southern Pacific R.R.
New Irr Dt
Exist 5"x6' Irr Ditch To Remain
RR Signals
Dirt Rd
Sta 64+60 154' New 30"x154' RCP New Str Hdwl Rt Lt Std C-9 C.O. #1.
Exist 12"x5"x615 Irrig Ditch
Exist 30"x30' CP Remove Exist 36" CP To Remain
Exist Conc Hdwl Remove
Lt Sta 60+00 to Sta 83+65 Rt Sta 60+00 to Sta 90+00 5300' New 4 BW Fence Std C-16 & C-16-A
Lt Sta 75+00 New 24"x70' Pipe Culv
Rt Sta 76+00 New 24"x70' Pipe Culv
Sta 80+92.12 To Sta 81+25.50 Exist 3-10"x4'x33'-6" Box Culv Ext 23'-0" Lt & 3'-0" Rt See Bridge Sheets
Exist 3-9x2.5 RR Bridge #941.75 15.2' Wide
Exist 30"x42.4' CP Remove & Salvage C.O. #4
Lt Sta 83+90 New 30"x48' RCP Spec Conc Hdwls Both Ends See Detail, Sh 17
Lt Sta 83+10 New 24"x70' Pipe Culv
Exist Conc Hdwl Remove
Exist 18"x10.3' CP Exist Hd Gate Rt Remove Pipe & Salvage Hd Gate
B.M. 058 67.3' Rt Sta 67+24.48 USC&GS Brass Cap (1934) Elev 1264.687 Note: This Is The Central B.M.
B.M. #70 98' Rt Sta 70+02.58 5/8" I.P. In Conc Elev 1269.26
B.M. #80 60' Rt Sta 80+01.40 5/8" I.P. In Conc Elev 1262.52
B.M. 26.3' Rt Sta 81+10.29 Ariz Hwy Brass Cap Elev 1265.14 On Rt Hdwll Of Box Stamped Elev 1265.15
B.M. #90 98' Rt Sta 90+02.58 5/8" I.P. In Conc Elev 1263.18
40' ROADWAY
Fence & Ditch Location
New Fence
Compacted Canal Banks
New 10"x250' Berm Top of Berm Elev 1270.50
1550' 2"x3' New Irr Dt 861 CY Dt Excav
2100' New 6"x5' Irr Dt 6,278 CY Dt Excav
Fin ¢ Grade
Top Of Existing Pavement
Irr Ditch Profile
-0.2917%
REDUCED SIZE DO NOT SCALE
39,104 CY Bor from Pit 1000' Rt Sta 75+00
Embt 29,915 Includes Berm, Dyke & T.O.'s
Grnd Comp 1,360
Bor 39,104
20% Shr 7,021
Lt Sta 73+90 New 24"x40' RCP 25 CY Str Excav 22 CY Spec Comp Spec Wing Type Hdwls 9.04 CY Class "A" Conc 754 lbs Reinf Steel
Lt Sta 81+00 New 30"x34' RCP Syphon 43 CY Str Excav 38 CY Spec Comp Spec Wing Type Hdwls 9.74 CY Class "A" Conc 754 lbs Reinf Steel
Lt Sta 83+90 New 30"x48' RCP 34 CY Str Excav 32 CY Spec Comp Spec Wing Type Hdwls 9.74 CY Class "A" Conc 754 lbs Reinf Steel
1280
1270
1260
60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90
PLATE 1 - PLAN - PROFILE
KEUFFEL & ESSER CO., NEW YORK
11 F-021-1(7) 6 OF 20

COOLIDGE--MESA HWY.
Dock--Maricopa County Line
Pinal County

Survey ℄
Office ℄ Const ℄
℄ Exist Roadway
17'
℄ Location Detail

Exist 30"x 76' 6 Syphon
Conc Hdwls Both Ends
To Remain

Exist 6'x4'x90' Dyke

Exist 6'x4'x92' Dyke
Reconstr to Shoulder Elev

New Conc Check Hdwl
See Detail, Sh 17

Exist 18"x10' C.P.
Headgate Lt End
Remove Pipe & Salvage Hd Gate

Exist Conc Hdwl
Remove

New Constr Easement

POT 90+01.10
Set R.P. Spike 2" Lt
EP's 4"x12" in Conc
98' Rt & 149' Lt

Lt Sta 94+20
New 18"x10' R.C.P.
Desel Salvaged Headgate Pt

Exist R/W

+43.16

Approx Ult Const Line

Exist 6'x4'x60' Dyke
Reconstr to Shoulder Elev

Exist
6'x4'x60
Dyke
To Remain

Exist R.R. Bridge
3-9'x4.3'x15' Wide
@ 94157

Sta 90+38.50 To Sta 90+72.00
Exist 3-10'x4'x33'-6" Box Culv
Ext 23'-0" Lt
See Bridge Sheets

B.M. 26.3' Rt Sta 90+56.73
Ariz Hwy Brass Cap Stamped Elev 1263.36
On Rt Hdwll Elev 1262.61

POT 100+01.10
Set R.P. Spike 2' Lt

Lt Sta 103+20
New 18"x10' R.C.P.
Desel Salvaged Headgate Pt

Exist 18"x10.5' C.P.
Headgate Pt End
Remove Pipe & Salvage Hd Gate

Sta 112+00 Lt
New 18"x32' Pipe Culv
Std C-9 A Hdwl Lt & Rt
C-11 Mod.
C.O. #8

Dirt Road

Approx Road Slope

New Conc Check Hdwl
See Detail, Sh 17

Exist Conc Hdwl
Remove

New Irr Ditches
See Detail Below
for Size, Location
& Quantities

Exist 18"x30' C.P.
Remove

Fill Within R/W
Exist 3'-9" Irr. Ditch

Survey ℄

N 42°36'45" W

Southern Pacific R.R.

℄ Exist Hwy 87

Constr ℄

Lt Sta 92+20 to Sta 110+90
Remove & Salvage Exist B/W Fence

Lt Sta 92+20 to Sta 110+90
Pt Sta 90+00 to Sta 120+00
4850' New 4 B/W Fence
Std C-16 & C-16-A

POT 110+01.10
Set R.P. Spike 2 Lt
EP's 4"x12" in Conc
93' Rt & 94' Lt

Exist 30"x31' C.P.
Conc Hdwls Both Ends
To Remain

Pt Sta 113+45
New 24"x50' Pipe Culv

Exist 30"x30.5' CMP
Remove & Salvage

Exist
6'x4'x98' Dyke
To Remain

Lt Sta 112+50
New 24"x70' Pipe Culv

Exist 24"x59.8' Syphon
Conc Hdwls Both Ends
To Remain

Exist 6'x4'x99' Dyke
Reconstr to Shoulder Elev
Exist 3'x2' Conc Headgates
To Remain
Exist 7'x20' Conc Hdwall
To Remain

Exist R/W

Exist 6'x4'x57' Dyke
To Remain

3-8'6"x4'5"x15.4'
Exist R.R. Bridge
@ 94108

Exist 6'x4'x57' Dyke
Reconstr to Shoulder Elev

Sta 116+12.10 To Sta 116+85.50
Exist 3-10'x4'x33'-6" Box Culv
Ext 23'-0" Lt
See Bridge Sheets

B.M. 26' Rt Sta 116+30.28
Ariz Hwy Brass Cap Stamped Elev 1255.10
On Rt Hdwll Elev 1254.97

B.M. 120 60' Rt Sta 120+01.48
5/8" I.P. In Conc Elev 1249.63

B.M. 10.0 62' Rt Sta 100+01.48
5/8" I.P. In Conc Elev 1255.60

B.M. 110 98' Rt Sta 110+02.58
5/8" I.P. In Conc Elev 1257.10

Lt Sta 112+00
New 18"x32' Pipe Culv
Std C-9 A Hdwl Lt & Rt
1.01 cy Class A Conc
1.0 # reinf Steel
20 cy Str Exc
10 cy Spec Comp

Lt Sta 113+00
New 120'-40' AC TO
Type C Std C-3

Dt Sta 113+00
New 120'-40' AC TO
Type C Std C-3

Dt Sta 113+40
New 4 Unit C.G.
Std C-14
44 CY Str Excav
10.53 CY Class 'A' Conc

Lt Sta 112+50
New 24"x70' Pipe Culv
43 CY Str Excav
18 CY Spec Comp

Dt Sta 113+45
New 24"x50' Pipe Culv
31 CY Str Excav
28 CY Spec Comp

Lt Sta 113+00
New 24"x70' AC TO
Type C Std C-3

Reconstr Exist Dyke
to Shoulder Elev
15 CY Emb

Reconstr Exist Dyke
to Shoulder Elev
15 CY Emb

Lt Sta 94+20
New 18"x10' R.C.P.
5 CY Str Excav
4 CY Spec Comp
Desel Salvaged Headgate Pt

New Conc Check Hdwl
4.07 CY Class A Conc
160 lbs Reinf Steel

Fence & Ditch Location

1850' New 2'-3" Irr Dt
1020 CY Dt Excav

1940' New 6'-5" Irr Dt
5992 CY Dt Excav

Lt Sta 103+20
New 18"x10' R.C.P.
5 CY Str Excav
4 CY Spec Comp
Desel Salvaged Headgate Pt

New Conc Check Hdwl
4.07 CY Class A Conc
160 lbs Reinf Steel

40' ROADWAY

Exist Ground Line

Compacted Const Banks

Irrig. Ditch Profile

Exp. Of Exist Pavement

F.L. Elev 1255.1
Exist Conc Drop

F.L. Elev 1253.9

F.L. Elev 1253.2
Exist Conc Drop

F.L. Elev 1250.9

C.P. Lt

REDUCED SIZE
DO NOT SCALE

1270
1260
1250

90 91 92 93 94 95 96 97 98 99 100 1 2 3 4 5 6 7 8 9 110 11 12 13 14 15 16 17 18 19 120

PLATE I - PLAN PROFILE O.P.R.&B.E. STANDARD
KEUFFEL & ESSER CO., NEW YORK.

JAMES M. SAYER
REGISTERED LAND SURVEYOR
ARIZONA U.S.A.

O.P.R. RECORD	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
Y	ARIZ	F-021-1(7)	7	22	Hurlbert 4-7-58

L.H. BELL & ASSOCIATES
LEAD
DATE
Designed by A.L. | Drawn by C.R. | Checked by E.O.

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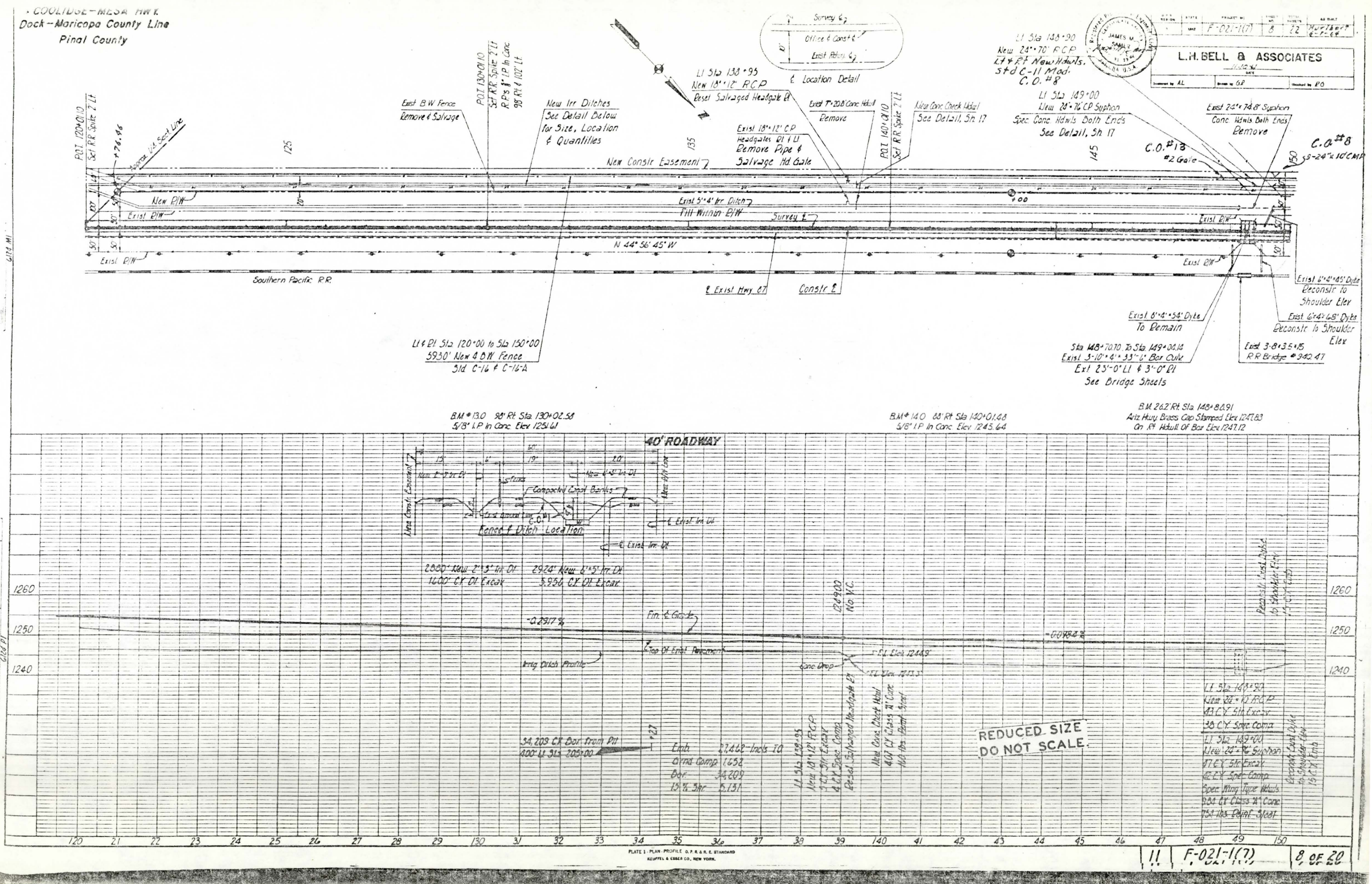
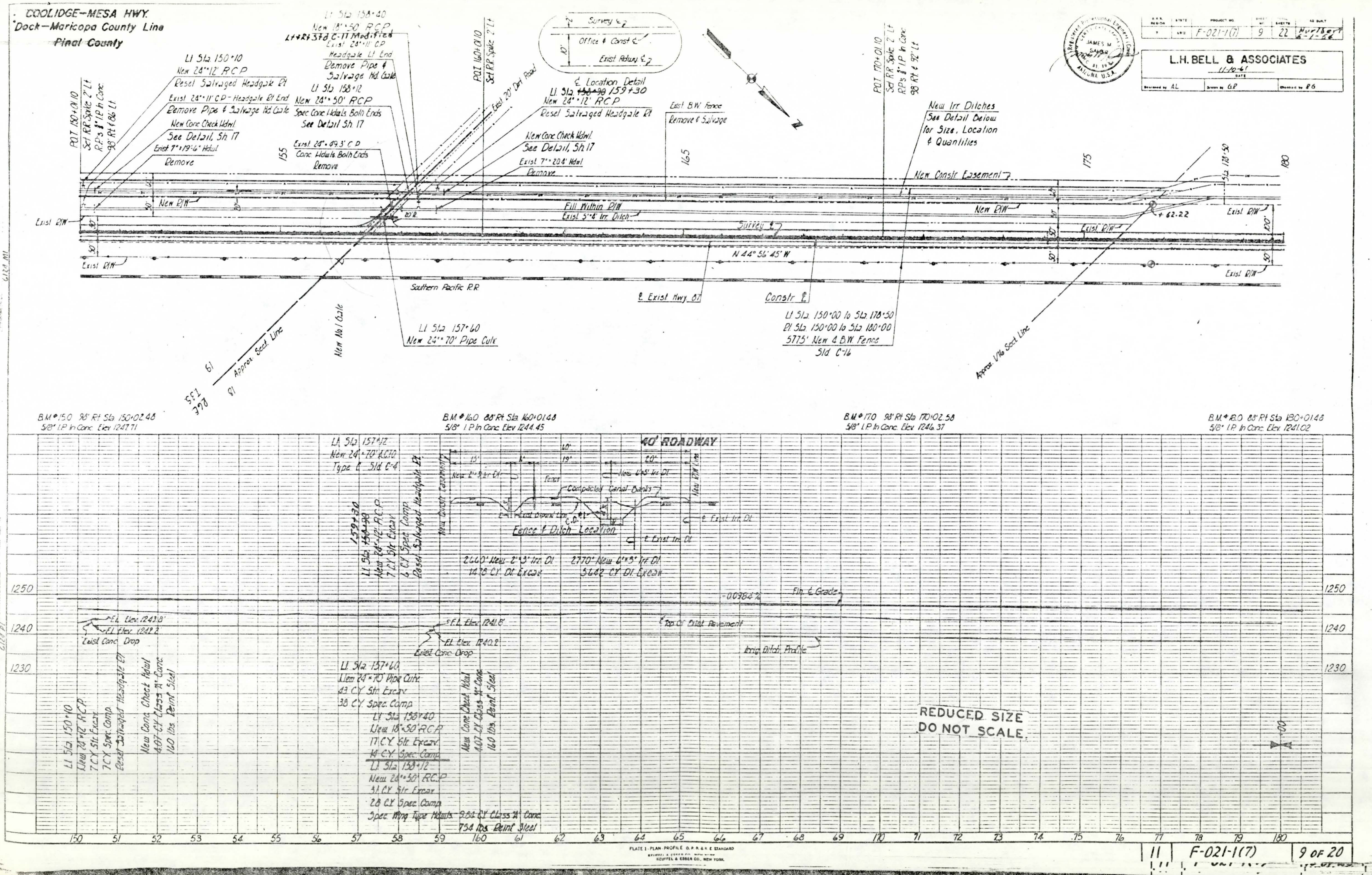

COOLIDGE-MESA HWY.
Dock-Maricopa County Line
Pinal County
F-021-1(7)
8
22
L.H. BELL & ASSOCIATES
JAMES M. SAMER
Survey ℄
Office ℄ Constr ℄
Exist Pvmt ℄
℄ Location Detail
P.O.T. 120+01.10 Set R.R. Spike 2' Lt
+76.96
Approx. U.S. Sect Line
125
Exist B.W. Fence Remove & Salvage
P.O.T. 130+01.10 Set R.R. Spike 2' Lt R.P.'s 1" I.P. In Conc 98' Rt & 102' Lt
New Irr Ditches See Detail Below for Size, Location & Quantities
New Constr Easement
135
Lt Sta 138+95 New 18"x12' RCP Reset Salvaged Headgate Rt
Exist 18"x12' CP Headgates Rt & Lt Remove Pipe & Salvage Hd Gate
Exist 7"x20.8' Conc Hdwl Remove
P.O.T. 140+01.10 Set R.R. Spike 2' Lt
New Conc Check Hdwl See Detail, Sh 17
145
Lt Sta 148+90 New 24"x70' RCP Lt & Rt New Hdwls. Std C-11 Mod. C.O. #8
Lt Sta 149+00 New 24"x76' CP Syphon Spec Conc Hdwls Both Ends See Detail, Sh 17
C.O. #13
#2 Gate
Exist 24"x74.8' Syphon Conc Hdwls Both Ends Remove
C.O. #8 5-24"x 10' CMP
150
New R/W
Exist R/W
Exist 5'x4' Irr Ditch Fill Within R/W
Survey ℄
+00
N 44° 56' 45" W
Exist R/W
Southern Pacific R.R.
℄ Exist Hwy 87
Constr ℄
Exist 6'x4'x45' Dyke Reconstr to Shoulder Elev
Exist 6'x4'x54' Dyke To Remain
Exist 6'x4'x68' Dyke Reconstr to Shoulder Elev
Sta 148+70.70 To Sta 149+04.14 Exist 3-10'x4'x33'-6" Box Culv Ext 23'-0" Lt & 3'-0" Rt See Bridge Sheets
Exist 3-8'x3.5'x15' R.R. Bridge #940.47
Lt & Rt Sta 120+00 to Sta 150+00 5930' New 4 BW Fence Std C-16 & C-16-A
B.M. #130 98' Rt Sta 130+02.58 5/8" I.P. In Conc Elev 1251.61
B.M. #140 88' Rt Sta 140+01.48 5/8" I.P. In Conc Elev 1245.64
B.M. 262 Rt Sta 148+80.91 Ariz Hwy Brass Cap Stamped Elev 1247.83 On Rt Hdwll Of Box Elev 1247.12
40' ROADWAY
Fence & Ditch Location
Compacted Canal Banks
New Constr Easement
℄ Exist Irr Dt
2880' New 2'x3' Irr Dt 1600 CY Dt Excav
2924' New 6'x5' Irr Dt 5,950 CY Dt Excav
1260
1250
1240
-0.2317%
Fin ℄ Grade
℄ Top Of Exist Pavement
Irrig Ditch Profile
Conc Drop
126+00 No V.C.
FL Elev 1244.9
FL Elev 1243.3
34,209 CY Bor. from Pit 400' Lt Sta 205+00
Emb. 27,462 Incls TO
Grnd Comp 1,658
Bor. 34,209
15% Shr. 5,131
Lt Sta 138+95 New 18"x12' RCP 3 CY Str Excav 4 CY Spec Comp Reset Salvaged Headgate Rt
New Conc Check Hdwl 4.07 CY Class "A" Conc 168 lbs Reinf Steel
REDUCED SIZE DO NOT SCALE
Lt Sta 148+90 New 24"x 70' RCP 43 CY Str Excav 38 CY Spec Comp
Lt Sta 149+00 New 24"x76' Syphon 17 CY Str Excav 16 CY Spec Comp Spec Wing Type Hdwls 9.84 CY Class "A" Conc 754 lbs Reinf Steel
Reconstr Exist Dyke to Shoulder Elev 15 CY Emb
120 21 22 23 24 25 26 27 28 29 130 31 32 33 34 35 36 37 38 39 140 41 42 43 44 45 46 47 48 49 150
PLATE 1 - PLAN - PROFILE G.P.R & R.E. STANDARD
KEUFFEL & ESSER CO., NEW YORK.
11
F-021-1(7)
8 of 20


COOLIDGE–MESA HWY.
Dock–Maricopa County Line
Pinal County
F-021-1(7)
9
22
L.H. BELL & ASSOCIATES
JAMES M.
ARIZONA U.S.A.
Survey ℄
Office & Const ℄
Exist Hdwy ℄
℄ Location Detail
P.O.T. 150+01.10
Set R.R. Spike 2' Lt
R.P.s ⅝" I.P. In Conc
98' Rt & 86' Lt
Lt Sta 150+10
New 24"×12' RCP
Reset Salvaged Headgate Rt
Exist 24"×11' C.P. – Headgate Rt End
Remove Pipe & Salvage Hd Gate
New Conc Check Hdwl
See Detail, Sh 17
Exist 7"×19'-6" Hdwl
Remove
Lt Sta 158+40
New 18"×50' RCP
Lt+Rt Std C-11 Modified
Exist 24"×11' CP
Headgate Lt End
Remove Pipe & Salvage Hd Gate
Lt Sta 158+12
New 24"×50' RCP
Spec Conc Hdwls Both Ends
See Detail Sh 17
Exist 24"×49.3' C.P.
Conc Hdwls Both Ends
Remove
P.O.T. 160+01.10
Set R.R. Spike 2' Lt
Exist 20' Dirt Road
Lt Sta 159+30
New 24"×12' RCP
Reset Salvaged Headgate Rt
New Conc Check Hdwl
See Detail, Sh 17
Exist 7"×20.4' Hdwl
Remove
Exist B.W. Fence
Remove & Salvage
P.O.T. 170+01.10
Set R.R. Spike 2' Lt
R.P.s ⅝" I.P. In Conc
98' Rt & 92' Lt
New Irr Ditches
See Detail Below
for Size, Location & Quantities
New Constr Easement
155
165
175
180
New R/W
Exist R/W
Fill Within R/W
Exist 5"×8' Irr Ditch
Survey ℄
New R/W
Exist R/W
+62.22
Sta 178+50
N 44° 56' 45" W
Southern Pacific R.R.
℄ Exist Hwy 87
Constr ℄
Lt Sta 150+00 to Sta 178+50
Rt Sta 150+00 to Sta 180+00
5775' New 4 B.W. Fence
Std C-16
Lt Sta 157+60
New 24"×70' Pipe Culv
New No. 1 Gate
Approx Sect Line
Approx 1/16 Sect Line
B.M. #150 98' Rt Sta 150+02.48
⅝" I.P. In Conc Elev 1247.71
B.M. #160 88' Rt Sta 160+01.48
⅝" I.P. In Conc Elev 1244.45
B.M. #170 98' Rt Sta 170+02.58
⅝" I.P. In Conc Elev 1246.37
B.M. #180 88' Rt Sta 180+01.48
⅝" I.P. In Conc Elev 1241.02
40' ROADWAY
Lt Sta 157+12
New 24"×70' L.C.T.O.
Type C Std C-4
New Ditch Easement
New 2'×3' Irr Dt
Fence
Compacted Canal Banks
New 6"×5" Irr Dt
New R/W Line
℄ Exist Irr Dt
Fence & Ditch Location
2660' New 2'×3' Irr Dt
1470 CY Dt Excav
2770' New 6"×5" Irr Dt
5642 CY Dt Excav
Lt Sta 159+30
New 24"×12' RCP
7 CY Str Excav
6 CY Spec Comp
Reset Salvaged Headgate Rt
-0.0384%
Fin ℄ Grade
Top Of Exist Pavement
Irrig Ditch Profile
F.L. Elev 1243.8'
F.L. Elev 1242.2'
Exist Conc Drop
F.L. Elev 1241.8'
F.L. Elev 1240.2'
Exist Conc Drop
1250
1240
1230
Lt Sta 150+10
New 24"×12' RCP
7 CY Str Excav
7 CY Spec Comp
Reset Salvaged Headgate Rt
New Conc Check Hdwl
4.07 CY Class "A" Conc
160 lbs Reinf Steel
Lt Sta 157+60
New 24"×70' Pipe Culv
43 CY Str Excav
38 CY Spec Comp
Lt Sta 158+40
New 18"×50' RCP
17 CY Str Excav
14 CY Spec Comp
Lt Sta 158+12
New 24"×50' RCP
31 CY Str Excav
28 CY Spec Comp
Spec Wing Type Hdwls 9.84 CY Class "A" Conc
754 lbs Reinf Steel
New Conc Check Hdwl
4.07 CY Class "A" Conc
160 lbs Reinf Steel
REDUCED SIZE
DO NOT SCALE
150 51 52 53 54 55 56 57 58 59 160 61 62 63 64 65 66 67 68 69 170 71 72 73 74 75 76 77 78 79 180
PLATE 1 · PLAN · PROFILE
KEUFFEL & ESSER CO. NEW YORK
11
F-021-1(7)
9 OF 20

COOLIDGE – MESA HWY.
Dock – Maricopa County Line
Pinal County

A.P.D. DESIGNATION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
7	ARIZ.	F-021-1(7)	10	22	Nov 15 1957 6-1-58

L.H. BELL & ASSOCIATES
Designed by AL | Drawn by GP | Checked by RG

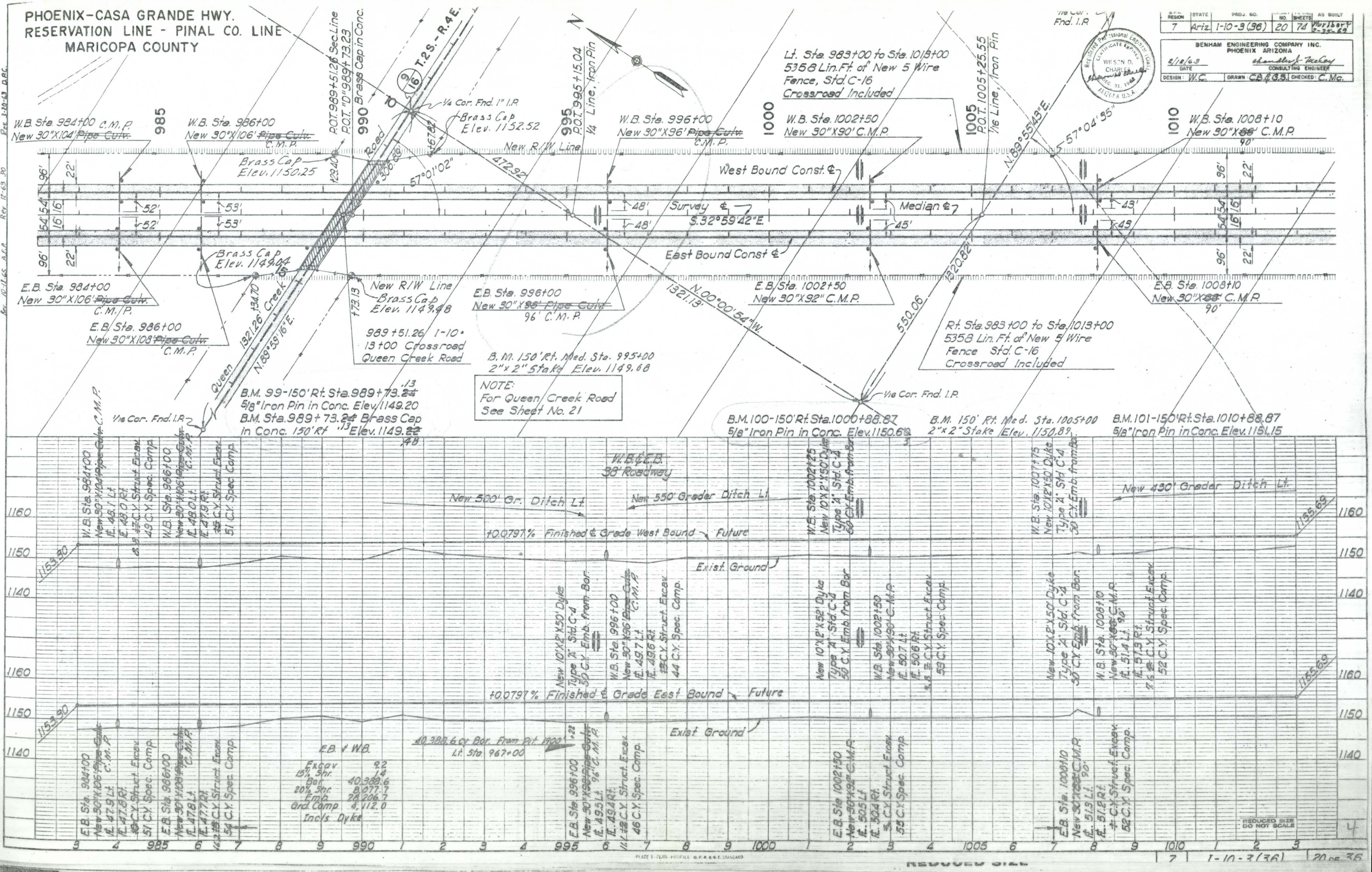
JAMES M. SAMER — REGISTERED PROFESSIONAL ENGINEER — ARIZONA U.S.A.

Exist 24"×.287" C.P. Conc. Hdwls Both Ends To Remain
Exist 24"×.832' Syphon Conc. Hdwls Both Ends To Remain
Exist 6'×4'×113' Dyke To Remain
Exist 6'×4'×113' Dyke Reconstr to Shoulder Elev
Exist 24"×.287" C.P. Headgate Lt End Remove Pipe & Salvage Hd Gate
New Conc Check Hdwl See Detail, Sh 17
Exist Conc Hdwl Remove
POT 180+01.10 Set R.P. Spike 2' Lt
POT 190+00 Set R.P. Spike 2' Lt
Sta 186+00
Exist R/W 100'
Exist R/W 50'
Survey ℄
Office & Const ℄
Exist Relwy ℄
℄ Location Detail
LT Sta 186+50 New 18"×12" R.C.P.
Reset Salvaged Headgate Pt
New Irr Ditches See Detail Below for Size, Location & Quantities
New Constr Easement
PC 197+24.33 Set R/R Spike 2' Lt
Lat 138.056
Dep 20627.551
EPs ¾" I.P. in Conc 90' Rt & 102' Lt
Constr ℄ Δ = 3°03'30" Lt D = 0°30'01.57" R = 11,449.16' T = 305.64' L = 611.13' Super = 0.015'/ft
PT 203+37.46 Set EPs ¾" I.P. in Conc 90' Rt 102' Lt Set RR Spike 2' Lt
Survey ℄ Δ = 3°03'30" Lt D = 0°30'01.89" R = 11,447.16' T = 305.59' L = 611.03'
"As Built" Δ = 3°00' Lt D = 0°30' R = 11,460.00' T = 300.2' L = 600.0'
EQUA – 0.10'
Exist 10' Deep Borrow Pit
C.O. #4. LT Sta 207+50 New 24"×.70' Pipe Culv 70'
205
Ditch
New R/W 50'
Exist R/W 50'
Exist R/W 50'
N 44° 56' 45" W
N 48° 00' 15" W
Survey ℄
Southern Pacific R/R
Constr ℄
RR Signal
Exist 6'×4'×58' Dyke To Remain
Sta 183+39.40 To Sta 183+73.02 Exist 3-10'×4'×33'-6" Box Culv Ext 25'-0" Lt & 5'-0" Rt See Bridge Sheets
Exist 3.9'×4'×15.2' R/R Bridge #939.81
Exist 6'×4'×63.4' Dyke Reconstr to Shoulder Elev
New Headgate
Queen Creek, Hidalgo, Gilbert Rd
East Bd Point
Exist 3'×2' Irr Dl Fill Within R/W
Exist D/W Fence Remove & Salvage Within R/W
LT Sta 186+20 to Sta 210+00 RT Sta 180+00 to Sta 210+00 5320' New 4 B/W Fence Std. C-16 & C-16-A
Mile Post 156 36.6 Rt Sta 201+73.3
Survey ℄ Δ = 3°03'30" Rt D = 0°29'58.1" R = 11,471.16' T = 306.23' L = 612.31'
Const ℄ Δ = 3°03'30" Rt D = 0°29'58.43" R = 11,469.16' T = 306.17' L = 612.20' Super = 0.015'/ft
P.C. 206+62.81 Set EP Spike 2' Lt EPs ¾" I.P. in Conc 98' Rt & 137' Lt
"As Built" Δ = 3°00' D = 0°30' R = 11,460.00' T = 300.2' L = 600.0'

B.M. South Curb of Cattle Gd. Brass Cap Sta 187+ Elev. 1245.56
B.M. 26.5' Rt Sta 183+57.79 Ariz Hwy Brass Cap Stamped Elev 1244. On Rt Hdwll Of Box Elev 1243.52 (Corrected)
B.M. #190 68' Rt Sta 190+01.48 5/8" I.P. In Conc. Elev 1239.67
B.M. #197 98' Rt Sta 197+27.81 PC 5/8" I.P. In Conc. Elev 1241.93
B.M. #206 137' Lt Sta 206+24.39 5/8" I.P. In Conc Elev 1241.41

40' ROADWAY
Dl Sta 186+85 New 24"×40' A.C.E.P. Type C Std C-5
Lt Sta 187+50 New 6 Unit C-6 Std C-16 42 CY Str Excav 1490 CY Class 'A' Conc
New 2'×3' Irr Dl
New 6'×5' Irr Dl
Fence
Compacted Canal Banks
Fence & Ditch Location
New Conc Ditch Lining
New D/W Line
Reconstr Exist Dyke to Shoulder Elev 15 CY Emb
Lt Sta 186+50 New 18"×12" R.C.P. 5 CY Str Excav 4 LF Spec Encas Reset Salvaged Headgate Pt
New Conc Check Hdwl 4.07 CY Class 'A' Conc 160 lbs Steel
895' New 2'×3' Irr Dl 497 CY Dl Excav
1956' New 6'×5' Irr Dl 1956 CY Dl Excav
-0.0384%
Fin ℄ Grade
Top Of Exist Pavement
Profile of the New Dl is to be the same as the existing Dl
400' V.C.
1245.00 Con 0.80'
-0.2963%
EQUATION Long Sta + 0.10' Sta 203 to Sta 204 = 100.10'
Lt Sta 207+30 New 24"×70' A.C.E.P. Type C Std C-5
Lt Sta 207+70 New 6 Unit C-6 Std C-16 44 CY Str Excav 10.55 CY Class 'A' Conc
Lt Sta 207+50 New 24"×59' Pipe Culv 70' 31 CY Str Excav 98 C.Y Spec Comp
REDUCED SIZE DO NOT SCALE.

PLATE 1 - PLAN - PROFILE U.P.R.&R.E. STANDARD
REUFFEL & ESSER CO., NEW YORK.


PHOENIX-CASA GRANDE HWY.
RESERVATION LINE - PINAL CO. LINE
MARICOPA COUNTY
7 | Ariz. | I-10-3 (36) | 20 | 74
BENHAM ENGINEERING COMPANY INC.
PHOENIX ARIZONA
CONSULTING ENGINEER
DESIGN: W.C.
DRAWN: CB&GS
CHECKED: C.Mc.
Lt. Sta. 983+00 to Sta. 1018+00
5358 Lin. Ft. of New 5 Wire
Fence, Std. C-16
Crossroad Included
Rt. Sta. 983+00 to Sta. 1018+00
5358 Lin. Ft. of New 5 Wire
Fence Std. C-16
Crossroad Included
W.B. Sta. 984+00 C.M.P.
New 30"X104' Pipe Culv.
W.B. Sta. 986+00
New 30"X106' Pipe Culv. C.M.P.
P.O.T. 989+51.26 Sec Line
P.O.T. "D" 989+73.23
Brass Cap in Conc.
1/4 Cor. Fnd. 1" I.P.
Brass Cap
Elev. 1152.52
T.2S.-R.4E.
P.O.T. 995+15.04
1/4 Line, Iron Pin
W.B. Sta. 996+00
New 30"X96' Pipe Culv. C.M.P.
W.B. Sta. 1002+50
New 30"X90' C.M.P.
P.O.T. 1005+25.55
1/16 Line, Iron Pin
W.B. Sta. 1008+10
New 30"X90' C.M.P.
New R/W Line
Brass Cap
Elev. 1150.25
West Bound Const. ℄
Survey ℄
S.32°59'42"E.
Median ℄
East Bound Const ℄
57°01'02"
57°04'35"
N.89°55'43"E.
N.00°00'54"W.
N.89°58'16"E.
1321.26
1321.13
1320.82
550.06
472.92
Queen Creek Road
Brass Cap
Elev. 1149.04
Brass Cap
Elev. 1149.48
E.B. Sta. 984+00
New 30"X106' Pipe Culv. C.M.P.
E.B. Sta. 986+00
New 30"X108' Pipe Culv. C.M.P.
989+51.26 I-10-13+00 Crossroad
Queen Creek Road
E.B. Sta. 996+00
New 30"X98' Pipe Culv. 96' C.M.P.
E.B. Sta. 1002+50
New 30"X92" C.M.P.
E.B. Sta. 1008+10
New 30"X90' C.M.P.
B.M. 150' Rt. Med. Sta. 995+00
2"x2" Stake Elev. 1149.68
NOTE:
For Queen Creek Road
See Sheet No. 21
1/16 Cor. Fnd. I.P.
B.M. 99-150' Rt. Sta. 989+73.13
5/8" Iron Pin in Conc. Elev. 1149.20
B.M. Sta. 989+73.13 Brass Cap
in Conc. 150' Rt Elev. 1149.48
B.M. 100-150' Rt. Sta. 1000+88.87
5/8" Iron Pin in Conc. Elev. 1150.63
B.M. 150' Rt. Med. Sta. 1005+00
2"x2" Stake Elev. 1150.89
B.M. 101-150' Rt. Sta. 1010+88.87
5/8" Iron Pin in Conc. Elev. 1151.15
W.B. & E.B.
38' Roadway
New 500' Gr. Ditch Lt.
New 550' Grader Ditch Lt.
New 430' Grader Ditch Lt.
+0.0797% Finished ℄ Grade West Bound - Future
Exist. Ground
+0.0797% Finished ℄ Grade East Bound - Future
Exist Ground
1153.90
1155.69
40,388.6 cy Bor. From Pit 1900+22
Lt. Sta. 967+00
E.B. + W.B.
Excav 9.2
15% Shr. 1.4
Bor 40,388.6
20% Shr. 8,077.7
Emb 28,206.7
Grd. Comp 4,112.0
Incls Dyke
1160
1150
1140
3 4 985 6 7 8 9 990 1 2 3 4 995 6 7 8 9 1000 1 2 3 4 1005 6 7 8 9 1010 1 2 3
REDUCED SIZE DO NOT SCALE
7 | I-10-3 (36) | 20 of 36

PHOENIX CASA GRANDE HWY.

RESERVATION LINE - PINAL CO. LINE
Maricopa County

~~Sta 870+00 to 877+00~~
~~Rt. & Lt.~~
~~Relocate 5 Wire Fence~~
~~Std. C-16 & A~~

FUTURE
~~Lt. W.B. & Rt. E.B.~~
~~Sta 870+00 to Sta 890+00~~
~~4000' New Road Guard~~
~~Std. C-7-1~~

~~New Construct Ditch~~
~~By Others~~

~~New Lt. Service Rd.~~
~~By Others~~

Sta. 3+62 Orng. No. 3004-2
New 30"-36" R.C. Pipe
In Place
Sta. 877+90 Med. & Lt.
New 24'x40' Pipe Culv.
In Place
Extnl 24"-22" Conc. Pipe
Remove

NOTE: Sta. 877+75 Med. &
~~36"x324' R.C.P. For Hdwl. Details, see Sheets 4A & 4B.~~
In Place

Extnl 1'-25' Conc. Lined Ditch
Fill

~~Future~~
~~Lt. Sta 870+00 to 870+00 W.B.~~
~~Rt. Sta 870+00 to 877+00 E.B.~~
~~4000' New Conc. Emb. Curb Std. C-3~~
New R/W

Future - New Rd. Gd. Std. C-7-1
Lt. 75' Straight, 75' Shop Curved, R=50', see detail Sht. #3

I-10-3 (53)
Sta. 877+78 Median ℄
New 36"-324' R.C. Pipe
9°12' Sk. Pt. In Place
New Catch Basin, Std. C-27-B (Modified) In Median
See Detail Sh. 4.
I-10-3(53)
Sta. 877+80 Med. ℄ Rt.
New 24"x34' Pipe Culv.
In Place

STA. 877+00
BEGIN I-10-3 (36)
End I-10-3 (53)

T15 - R4E

T25 - R4E

GILA RIVER INDIAN RESERVATION

N

New Road Guard, Std. C-7-1
Lt. 1,275' Straight
Lt. 25' Shop Curved, R=50'
See Detail Sht. #3

Equipment Crossing
Sta. 878+03.26 Med. ℄
New 16'x14'x180'-6" Box Culv.
9°12' Skew Rt.
See Bridge Sheets

Future - New Rd. Gd., Std. C-7-1
Rt. 75' Straight, 25' Shop Curved, R=50', see Sht. #3

Future
Lt. Sta 877+00 to 896+60 W.B.
1880' New Conc. Emb. Curb
Std. C-3

W.B. Constr ℄	℄ Median	E.B. Constr ℄
Δ = 32°59'00" Lt.	Δ = 32°59'00" Lt.	Δ = 32°59'00" Lt.
D = 0°30'08.52"	D = 0°30'00"	D = 0°29'51.56"
R = 11,405.16'	R = 11459.16'	R = 11,513.16'
T = 3376.56'	T = 3392.54'	T = 3408.53'
L = 6565.58'	L = 6596.67'	L = 6627.75'
Super = 0.015 Rt.		Super = 0.015 Rt.

Pt. ℄ Lt.
Sta 877+00 to Sta 898+00
4260' New 5 Wire Fence
Std. C-16 & C-16-A

Sta 897+90
New 36"x300' R.C.P.

New R/W

Survey ℄ Median ℄

W.B. Constr ℄

E.B. Constr ℄

Sta 878+30 Median ℄
New 30"-~~324'~~ R.C. Pipe 302'
9°12' Sk. Pt.

Future
1300' New Rd. Gd. Rt.
Std. C-7-1

POC Sta 878+03.28
Section Line

B.M. Sta 878+00 Brass Cap in Lt. Hdwl. Conc. Box. Elev. 1171.54

B.M. 88.150' Lt. & Sta 880+00
5/8" I.P. & Guard - Elev. 1156.38

B.M. 8' Rt. Med. Sta 880+00
Iron Pipe. Elev. 1167.07

Note: For Spec. Spillway Sta. and Length see detail sheet #4

B.M. 8' Rt. Med. Sta. 884+00
Iron Pipe. Elev. 1163.38

Sta 888+00 Median ℄
New 24"-120 ~~Pipe Culv.~~ C.M.P.
New No. 5 C.B. Std. C-27-B

B.M. ℄ Med. Sta. 888+00
Brass Cap in C.B. Elev. 1159.68

B.M. 8' Rt. Med. Sta. 898+00
Iron Pipe. Elev. 1149.20
B.M. 150' Lt. Med. Sta. 898+00
Brass Cap. Elev. 1149.23
B.M. 80' Rt. Med. Sta. 894+00
Iron Pipe. Elev. 1152.50
B.M. 8' Rt. Med. Sta. 890+00
Iron Pipe. Elev. 1157.19

Remove Within R/W
Extnl 4' Rd. Dirt Fence
Extnl 15'-4' Dirt Canal
Fill Within R/W
Extnl 12' Wide Dirt Road

404600.00

Pt. ℄ 877258.08

L.H. BELL & ASSOCIATES
5-4-62
Designed by G.R. | Drawn by G.R. | Checked by R.A.

NO.	ROAD	NO.	SHEETS
7	I-10-3(36)	8	74

Horizontal 1"=40' 5-21-62

Rev. 2-9-65 J.B.F.
Rev. 10-15-65
Rev. B.E.P. 10-15-65

2-38' ROADWAYS

Vertical 1"=10'
Horizontal 1"=40'

Elev. 1167.00

Slope -0.10 % Lt.

Slope -0.10 % Lt.

WESTBOUND PROFILE

EASTBOUND PROFILE

Existing Ground Line

Future W.B. Finished ℄ Grade

Future E.B. Finished ℄ Grade

Median Grade

-0.1951 %
0.2083 %
-0.1905 %
-0.1905 %
-1.2500 %
-1.0000 %
-0.0751 %
-0.0759 %

1600' V.C.
S.D. = 1460'
S.D. = 1450'
Sta 88+00
117300
Corr. 2.11'
Corr. 2.35'

54 C.Y. Emb. over Box Culv. from 3/4 Excav. For Details See Sh. 5

New Catch Basin Std. C-27-B (Modified)
New 18"-42" R.C. Pipe

New 30"-36" R.C. Pipe
9°12' Sk. Pt.

Sta 88+00 Median ℄
New 30"-36" R.C. Pipe
9°12' Sk. Pt.

48.6 C.Y. Sta Excav.
241 C.Y. Spec. Comp.

New 24"-120 Pipe Culv.
New No. 5 C.B. Std. C-27-B
67 C.Y. Spec. Comp.
74.8 C.Y. Sta. Excav.
New 10'-2"x24" Dyke
Tape B' Std. C-4
16 C.Y. Emb.
From Bor

New 36"-300' R.C.P.
New 11'-4" Asphalt Pt. & Lt.
Std. C-9-A
9½ Rds. @ Sta. Excav.
250 C.Y. Spec. Comp.
440 C.Y. Classified Comp.
Sta 899+00 Median ℄
New 36"-399' R.C.P.

End Prop. I-10-3 (53)

Sta. 877+45

Earthwork

Str. Excav.	384.0
15% Str.	57.6
Borrow	206,763.6
20% Str.	41,352.7
Emb.	156,174.8
Gr. Comp.	9,562.5

Incl's Fill for Canal

206,763.6 C.Y. Borrow
From Area 3 - 2200' Rt. Sta. 946+00

B.P. 892+81.10

710 C.Y. in R/W Canal Within R/W

REDUCED SIZE DO NOT SCALE

7	I-10-3(36)	8	OF 36
7	I-10-3(36)	9	OF 36

PHOENIX - CASA GRANDE HWY.
RESERVATION LINE - PINAL CO. LINE
MARICOPA COUNTY

BPR Region	STATE	PROJECT NO.	Sheet No.	Total Sheets	AS BUILT
7	ARIZ	I-10-3(36)	10	74	Plot [illegible] 3-27-69

Rev. 2-18-66 JPO Rev. 10-15-65 R.E.P. Rev. 10-8-62 R.E.P. Rev. 10-8-62 O.L.C.

Drawn 6/1957 — Designed — W. Shipley 9-62 — Traced — T. Miller 10-62 — Checked — Alvin Check — Quantities — Approved — 6/25/71

Sta. 23+15.04 to Sta. 26+84.96
New 4 span 5 Steel Girder Overpass
47° 30' 19" Sk. Rt. 2-16' Clear Rdwys.
See Bridge Sht.

Rt. Sta. 17+40 Rp "D" to Rt. Sta. 26+20 Maricopa Rd.
1,025' New 5 Wire Fence
Std. C-16

Rt. Sta. 26+12.91 to 47+00
2160' New 5 Wire Fence
Std. C-16

Rt. Sta. 26+70 to 32+00
Lt. 27+10 to 32+00
984 Lin. Ft. total New conc. emb. curb. Std. C-3

Future
262' New Type "A" Single Curb
h=7" Std. C-20

Exist. 36"x40' R.C.P.
Remove
C.O. #2

300' New Rd. Gd. Rt.
Std. C-7-1

100' Rt. 26+12.91 and 150' Lt. 913+16.65 Med. ℄
Brass Cap Flush 1'SO. & 1'

Med. Sta. 914+96.93 to 915+44.07
New 3-10'x7'x 258'-6" Box Culv.
Std. C1-10-3-45° Sk. Lt.

Future
New Rd. Gd. Std. C-7-1
Lt. 425' Straight
Lt. 25° Shop Curved, R=50'
See detail Sht. #3

Lt. Sta. 913+16.65 to 925+50
1734' New 5 Wire Fence
Std. C-16

Future
206' New Type "E"
Single Curb, Std. C-20

Future
203' New Type "A"
Single Curb, h=7"
Std. C-20

150' Lt. 925+43.08 P.T. - 920+49.91 Ahd.

150' Rt. 927+00 Med. ℄ Survey ℄

New R/W

W. B. ℄ — Median ℄ Survey — E. B. ℄

Sta. 36+50
New 36"x 200' R.C.P.
Irr. Hdwls. Rt. & Lt.
Std. C-9-A

Sta. 42+00
New Irr. Canal
88' Rt. 40+27.08 P.C. "N.B."
Constr. Easem't
Existing R/W
Existing 15'±' Irr. Canal Fill within R/W

Existing R/W
112' Lt. 40+27.08 P.C. "NB"
Lt. Sta. 36+40 to 47+00
1130' New 5 Wire Fence
Std. C-16

New Rd. Gd. Std. C-7-1
Rt. 725' Straight
Rt. 25° Shop Curved, R=50'
See Detail Sht. "3"

New Type 1 Gate
Locked
112' Lt.
36+40 N.B. — 48' Rt. P.O.C. Sta. 17+40.15 Bk. — 87+30.65 Ahd.

Lt. Sta. 898+00 to Lt. Sta. 36+40 "N.B."
830' New 5 Wire Fence
Std. C-16

Sta. 92+00
New 24"x 70' Pipe Culv.
Constr. Easem't

70' Rt. Sta. 91+75 Ramp "D"
New 24"x 42" Pipe Culv. Syphon
Str. Hdwl. Rt. & Lt. Std. C-9
under Irr. Canal

Sta. 897+90 Med. ℄ — 250' Lt. 90+00
New 36"x 300' R.C. Pipe Culvert
(Irr.) New Irr. Headwalls
Rt. & Lt. Std. C-9-A

150' Lt. 898+00

Brass Cap Elev. 1147.75

Existing 15'±' Irr. Canal

Fill

"WB" ℄

Median ℄ Survey ℄

"EB" ℄

New R/W

Constr. Easement

Future
205' New Type "A" Single Curb
h=7" Std. C-20

Sta. 902+00 Med. ℄
New Std. C-27-B No. 5 C.B.
24"x 208' Pipe Culvert Rt. & Lt.
w. Cor. Catch Basin.
B.M. Elev. 1146.38.

New 12' Grader Road

Rt. Sta. 898+00 to 910+00
1200' New 5 Wire Fence
Std. C-16

Sta. 6+60 "A"
New 24"x 68' C.M.P.

150' Rt. 910+00

Future
206' New Type "E"
Single Curb, Std. C-20

Future
206' New Type "E"
Single Curb, Std. C-20

Brass Cap Elev. 1146.00

Sta. 11+00 "A" 13+60
New 24"x 78' Pipe Culv.
New Std. C-27-B No. 5 C.B.
32' Lt.

175' New Rd. Gd. Lt.
Std. C-7-1

Future
Rt. Sta. 10+00 to 19+50 Ramp "A"
932' New Conc. Emb. Curb
Std. C-3

Brass Cap Elev. 1147.00

265' Rt. 914+00

New R/W

Future
203' New Type "A"
Single Curb, h=7"
Std. C-20

Lt. Sta. 19+73 to 23+33 and
Rt. Sta. 18+00 to 23+00 "Maricopa"
682 Lin. Ft. total New Conc. Emb.
Curb. Std. C-3.

Brass Cap Elev. 1149.02

4 Guide Posts Type "A" Std. C-8-2

New Type 1 Gate Locked

Existing R/W

Maricopa Rd. Sta. 15+26.02 to 15+61.98
New 3-10'x 7'x 84'-6" Box Culv.
Std. C1-10-3-22° Sk. Lt.
See Bridge Sht.

Remove Exist 36"x 46" R.C.P. Culvert

Rt. Sta. 910+00 E.B. to Lt. Sta. 6+00 Maricopa Rd.
2100' New 5 Wire Fence
Std. C-16

Existing R/W

100'

24' oil mat

New 6 unit C.G. with Gate
Locked Std. C-14

Constr. Easem't

Sta. 23+45.04
℄ Deg. of Bridge

Sta. 28+84.96
End of Bridge

Exist 18"x 68' R.C.P. Syphon
Remove

18+00 "E" New 24"x 48' C.M.P.
Sk. 5° Lt. ~~Std. C-9 Str. Hdwls. 14' Rt. & 34' Lt.~~

New Rd. Gd. Std. C-7-1
Lt. 200' straight
Lt. 25° shop curved, R=50'
See detail Sht. #3

Sta. 9+50 Med. ℄
New Std. C-27-B No. 5 C.B.
New 24"x 240' Pipe Culv. Rt. & Lt.
Sk. = 15° Lt.

New Rd. Gd. Std. C-7-1
Rt. 275' straight
Rt. 25° shop curved, R=50'
See detail Sht. #3

New Ditch

Future
New Rd. Gd. Std. C-7-1
Rt. 450' Straight
Rt. 25° Shop Curved, R=50'
See detail Sht. #3

20056' Total New Type "A"
Single Curb, h=7, Std. C-20

16+93 "Maricopa" Rt.
New 24"x 40' C.M.P. Culv.

Rt. Sta. 13+00 Rp "C" to Rt. Sta. 27+00 E.B.
1190' New 5 Wire Fence

165' Rt. 924+00

Brass Cap Elev. 1148.27

370' Rt. 928+65

Brass Cap Elev. 1147.34

Rt. Sta. 17+00 Rp "A" to Rt. Sta. 29+32 Rp "B"
1165' New 5 Wire Fence
Std. C-16

Rt. Sta. 6+00 to 13+00
750' New 5 Wire Fence
Std. C-16

700' New Type "A" Single Curb
h=7", Std. C-20 Future

Brass Cap Elev. 1143.49

390' New Type "A" Single Curb
h=7", Std. C-20

Existing R/W

12 Guide Posts Type "A" Std. C-8-2

Rt. Sta. 13+00 Maricopa

100' Rt.

RAMP "A"

RAMP "B"

RAMP "C"

RAMP "D"

RAMP "E"

"Conn D"

"MARICOPA"

"NB"

"B-C"

New Rd. Gd. Std. C-7-1
Lt. 25° Shop Curved, R=50'
See detail Sht. #3

Future
New Rd. Gd. Std. C-7-1
Rt. 450' Straight
Rt. 25° Shop Curved, R=50'
See detail Sht. #3

Sta. 25+00.00 P.O.T. "Maricopa" ℄
913+32.55 P.O.C. Med. & Survey ℄

Sta. 92+00 Med. ℄
New Std. C-27-B No. 5 C.B.
24"x 208' Pipe Culvert Rt. & Lt.
w. Cor. Catch Basin.

Sta. 20+84.96
End of Bridge

Sta. 23+15.04

Sta. 26+84.96

Sta. 36+40 "N.B."

Sta. 42+00

Sta. 47+00

Sta. 36+50

Sta. 92+00

Sta. 897+90 Med. ℄

Sta. 902+00 Med. ℄

Sta. 910+00

Sta. 914+96.93

Sta. 925+50

Sta. 9+50 Med. ℄

Sta. 11+00 "A"

Sta. 6+60 "A"

Sta. 16+93 "Maricopa"

Sta. 18+00 "E"

Sta. 25+00.00 P.O.T. "Maricopa" ℄

Sta. 36+40 "N.B."

Sta. 42+00

Sta. 47+00

Sta. 36+50

Sta. 92+00

Sta. 897+90 Med. ℄

Sta. 902+00 Med. ℄

Sta. 910+00

Sta. 914+96.93

Sta. 925+50

Sta. 9+50 Med. ℄

Sta. 11+00 "A"

Sta. 6+60 "A"

Sta. 16+93 "Maricopa"

Sta. 18+00 "E"

Sta. 25+00.00 P.O.T. "Maricopa" ℄

Rt. Sta. 15 to 95 Ramp "D"
Rt. Sta. 36+50 to 48+00 Maricopa Rd.
2,220 Sq. Yds. Total
390' New Type "A" Single Curb
h=7", Std. C-20 Future

648' New Type "A" Single Curb
h=7", Std. C-20

Rt. Sta. 31+70 to 36+50 Maricopa Rd.

Compacted Fill

2" Pneumatically Placed Mortar

Compacted Fill

NOTE:
For Spec. Spillway Sta. & Length see Sheet No. 4.

REDUCED SIZE DO NOT SCALE

PHOENIX - CASA GRANDE HWY.
RESERVATION LINE - PINAL CO. LINE
MARICOPA COUNTY

MARICOPA RD. INTERCHANGE
CONTOUR GRADING PLAN

TO ACCOMPANY CHANGE ORDER NO. 3

B.P.R. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
7	ARIZ.	I-10-3(36)	10A		Mar 16 or 2-27-69

J.L.L. June 1966

Book 6259 71

EARTH WORK

AREA ONE

Excav.	156.1
15% Shr.	23.4
Bor.	7,412.6
20% Shr.	1,482.5
Emb.	6,062.8

AREA TWO

Excav.	588.7
15% Shr.	88.3
Bor.	17,990.6
20% Shr.	3,598.1
Emb.	14,892.9

AREA THREE
See Next Sheet

NOTE:
EARTH WORK QUANTITIES AS SHOWN ARE ADDITIONAL QUANTITIES, IN EXCESS OF THOSE REQUIRED BY STANDARD SLOPES.

N

Ramp "D" 17+40.15 Bk.
87°-90'-65" Ahd

"MARICOPA"

Maricopa Road

RAMP "D"

RAMP "E"

RAMP "A"

AREA ONE

AREA TWO

AREA THREE

W.B. Constr. ℄

Median ℄ Survey ℄

E.B. Constr. ℄

Sta. 25+00.00 Maricopa Road
Sta. 913+32.55 Median ℄ Survey ℄

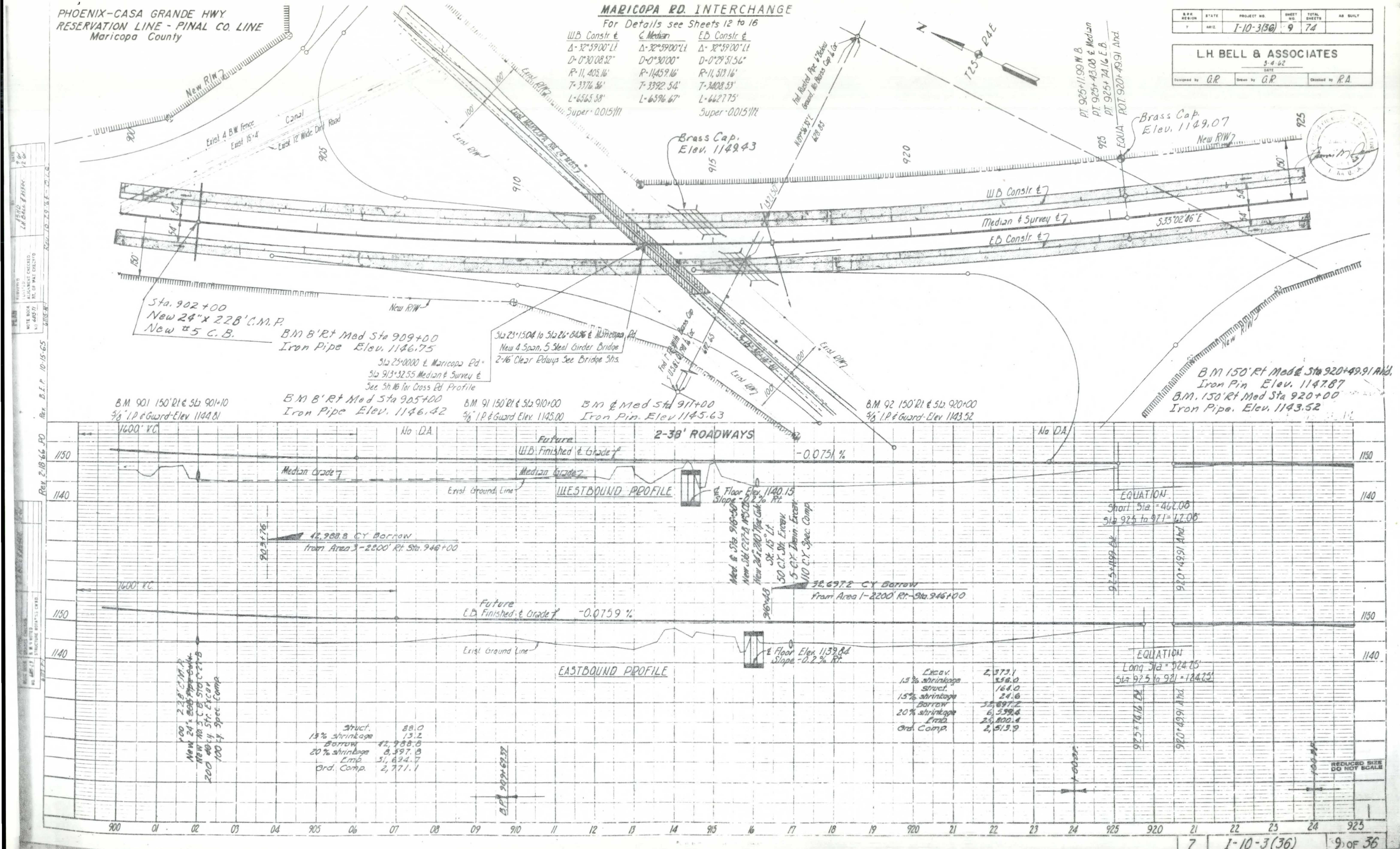
MATCH LINE

NEW PIPE AND QUANTITY SCHEDULE (This Sheet)

	STATION	SIZE	LENGTH	C.M.P. GA.	INSTALL.	CONCRETE BEDDING	CLASS	END SECTIONS	STR. EXCAV.	SPEC. COMP.	DRAIN. EXCAV.	REMARKS
(1)	W.B. ℄ 904+78	24"	80'	14	1	C	III	2	5 C.Y.	45 C.Y.	5 C.Y.	Grade Median between Sta. 902+00± & Sta. 912+00± to drain to Sta. 905+00.
(2)	E.B. ℄ 905+22	24"	92'	14	1	C	III	2	5 C.Y.	50 C.Y.	5 C.Y.	
(3)	RAMP "A" 13+60	24"	120'	14	1	C	IV	1 Rt.	5 C.Y.	65 C.Y.	5 C.Y.	New No. 3A C.B. Std. C-27-1 - Lt.
(4)	RAMP "E" 16+85	24"	66'	14	1	C	III	2	5 C.Y.	35 C.Y.	5 C.Y.	

REDUCED SIZE DO NOT SCALE

CONTOUR INTERVAL - 1'


PHOENIX-CASA GRANDE HWY.
RESERVATION LINE - PINAL CO. LINE
Maricopa County
MARICOPA RD. INTERCHANGE
For Details see Sheets 12 to 16
W.B. Constr. ℄ Δ-32°59'00" Lt. D-0°30'08.52" R-11,405.16' T-3376.56' L-6565.58' Super 0.015'/ft
℄ Median Δ-32°59'00" Lt. D-0°30'00" R-11,459.16' T-3392.54' L-6596.67'
E.B. Constr. ℄ Δ-32°59'00" Lt. D-0°29'51.56" R-11,513.16' T-3408.53' L-6627.75' Super 0.015'/ft
L.H. BELL & ASSOCIATES
I-10-3(36) 9 74
Designed by G.R. Drawn by G.R. Checked by R.A.
T.2S. R.4E.
New R/W
Canal
Exist. 4 B.W. Fence
Exist. 12' Wide Dirt Road
Exist. R/W
Brass Cap. Elev. 1149.43
Brass Cap. Elev. 1149.07
PT. 925+11.99 W.B.
PT. 925+43.08 ℄ Median
PT. 925+74.16 E.B.
EQUA. POT. 920+49.91 Ahd.
W.B. Constr. ℄
Median ℄ Survey ℄
E.B. Constr. ℄
S33°02'46"E
Sta. 902+00
New 24" x 228' C.M.P.
New #5 C.B.
B.M. 8' Rt. Med. Sta. 909+00 Iron Pipe Elev. 1146.75
Sta. 23+15.04 to Sta. 26+84.96 ℄ Maricopa Rd.
New 4 Span, 5 Steel Girder Bridge
2-16' Clear Rdwys. See Bridge Shs.
Sta. 25+00.00 ℄ Maricopa Rd. = Sta. 913+32.55 Median ℄ Survey ℄
See Sh. 16 for Cross Rd. Profile
B.M. 901 150' Rt. ℄ Sta. 901+10 5/8" I.P. & Guard Elev. 1144.81
B.M. 8' Rt. Med. Sta. 905+00 Iron Pipe Elev. 1146.42
B.M. 91 150' Rt. ℄ Sta. 910+00 5/8" I.P. & Guard Elev. 1145.00
B.M. ℄ Med. Sta. 911+00 Iron Pin Elev. 1145.63
B.M. 92 150' Rt. ℄ Sta. 920+00 5/8" I.P. & Guard Elev. 1143.52
B.M. 150' Rt. Med. ℄ Sta. 920+49.91 Ahd. Iron Pin Elev. 1147.87
B.M. 150' Rt. Med. Sta. 920+00 Iron Pipe Elev. 1143.52
1600' V.C.
No D.A.
2-38' ROADWAYS
Future W.B. Finished ℄ Grade
Median Grade
-0.0751 %
Exist. Ground Line
WESTBOUND PROFILE
℄ Floor Elev. 1140.15 Slope -0.2 % Rt.
EQUATION Short Sta. = 462.08 Sta. 925 to 971 = 42.08
42,988.8 C.Y. Borrow from Area 3 - 2200' Rt. Sta. 946+00
32,697.2 C.Y. Borrow From Area 1 - 2200' Rt. Sta. 946+00
Future E.B. Finished ℄ Grade
-0.0759 %
EASTBOUND PROFILE
℄ Floor Elev. 1139.84 Slope -0.2 % Rt.
EQUATION Long Sta. = 524.25' Sta. 925 to 971 = 124.25'
Excav. 2,373.1
15% shrinkage 356.0
Struct. 164.0
15% shrinkage 24.6
Borrow 32,697.2
20% shrinkage 6,539.4
Emb. 28,800.4
Ord. Comp. 2,513.9
Struct. 88.0
15% shrinkage 13.2
Borrow 42,988.8
20% shrinkage 8,597.8
Emb. 31,634.7
Ord. Comp. 2,771.1
100 228' C.M.P. New 24" x 288 Pipe Culv. New No. 5 C.B. Sta. C 27+8 200 C.Y. Str. Excav. 100 C.Y. Spec. Comp.
REDUCED SIZE DO NOT SCALE
900 01 02 03 04 905 06 07 08 09 910 11 12 13 14 915 16 17 18 19 920 21 22 23 24 925 920 21 22 23 24 925
7 I-10-3(36) 9 OF 36

PHOENIX - CASA GRANDE HWY.
RESERVATION LINE - PINAL CO. LINE
MARICOPA COUNTY

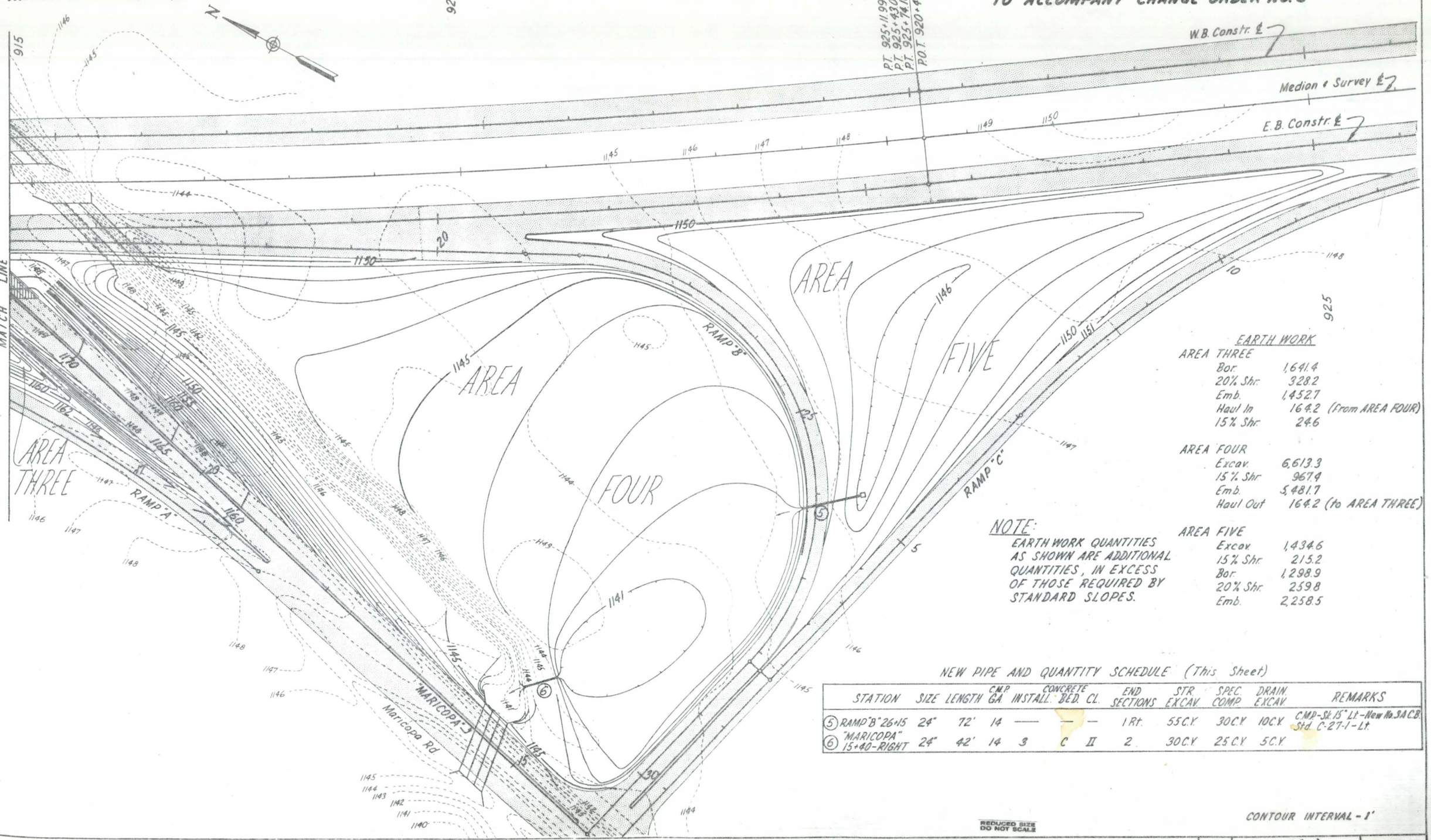
MARICOPA RD. INTERCHANGE
CONTOUR GRADING PLAN

REGION	STATE	PROJECT NO.	SHEET NO	SHEETS	AS BUILT
7	ARIZ.	I-10-3(36)	108		Hurlbert 2-27-69

TO ACCOMPANY CHANGE ORDER NO. 3

J.L.L. June 1966

Book 6259 TI



EARTH WORK

AREA THREE	
Bor.	1,641.4
20% Shr.	328.2
Emb.	1,452.7
Haul In	164.2 (From AREA FOUR)
15% Shr.	24.6
AREA FOUR	
Excav.	6,613.3
15% Shr.	967.9
Emb.	5,481.7
Haul Out	164.2 (to AREA THREE)
AREA FIVE	
Excav.	1,434.6
15% Shr.	215.2
Bor.	1,298.9
20% Shr.	259.8
Emb.	2,258.5

NOTE:
EARTH WORK QUANTITIES AS SHOWN ARE ADDITIONAL QUANTITIES, IN EXCESS OF THOSE REQUIRED BY STANDARD SLOPES.

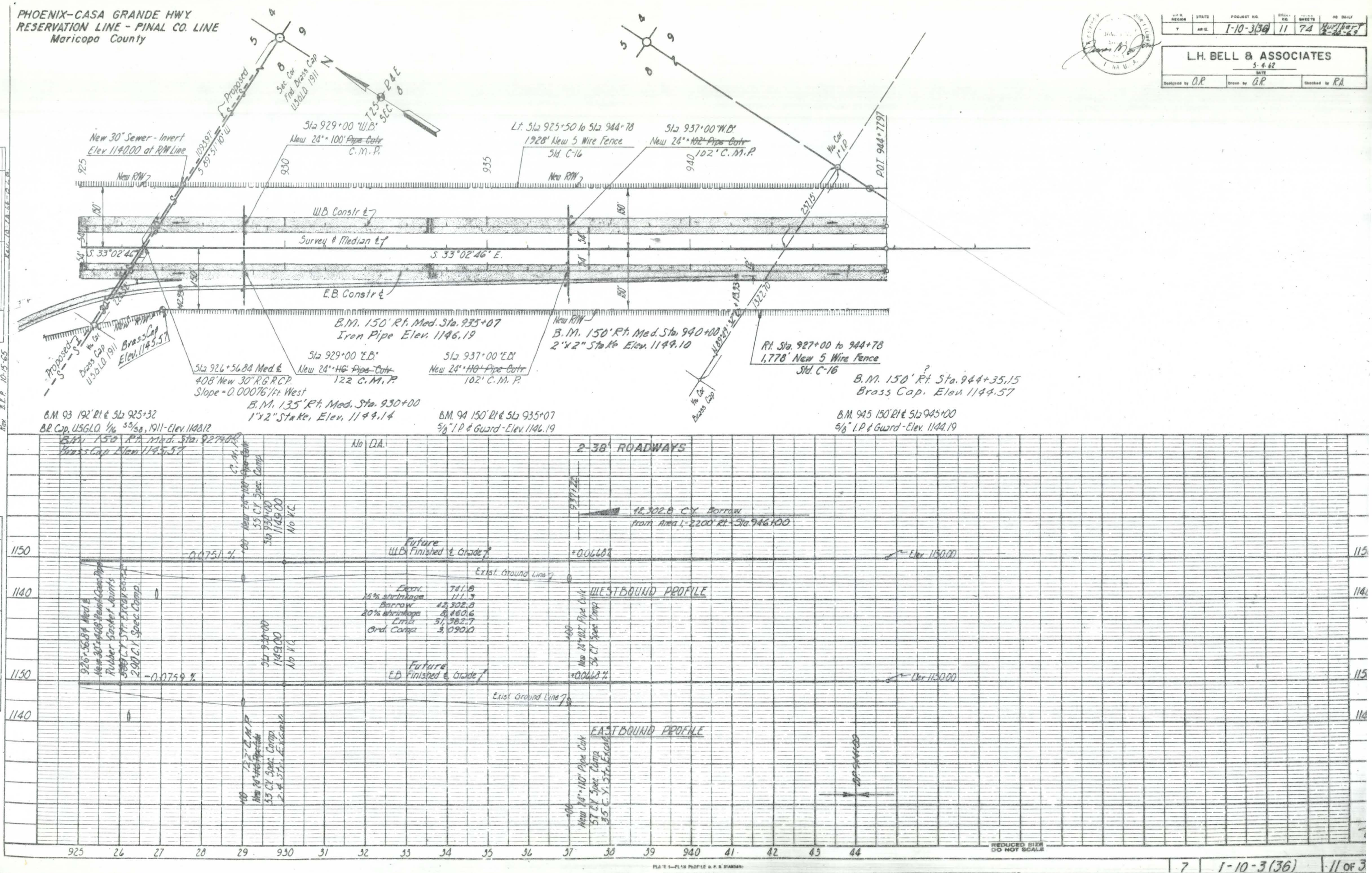
NEW PIPE AND QUANTITY SCHEDULE (This Sheet)

	STATION	SIZE	LENGTH	C.M.P. GA.	INSTALL.	CONCRETE BED.	CONCRETE CL.	END SECTIONS	STR. EXCAV.	SPEC. COMP.	DRAIN. EXCAV.	REMARKS
(5)	RAMP "B" 26+15	24"	72'	14	——	—	—	1 Rt.	55 C.Y.	30 C.Y.	10 C.Y.	C.M.P.-St. 15° Lt.-New No. 3 A.C.B. Std. C-27-1-Lt.
(6)	"MARICOPA" 15+40-RIGHT	24"	42'	14	3	C	II	2	30 C.Y.	25 C.Y.	5 C.Y.	

CONTOUR INTERVAL - 1'

REDUCED SIZE DO NOT SCALE

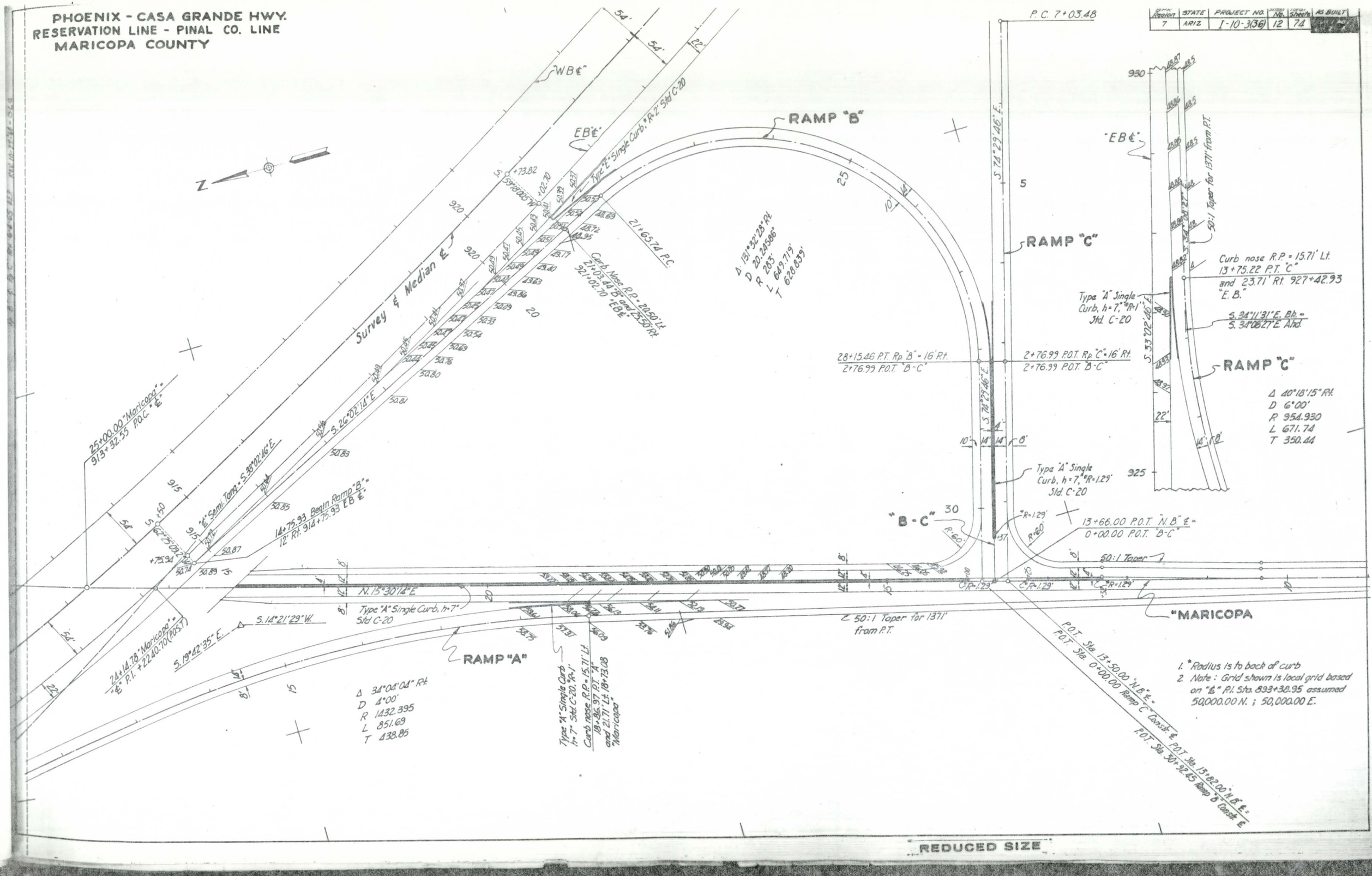
REDUCED SIZE



PHOENIX-CASA GRANDE HWY.
RESERVATION LINE - PINAL CO. LINE
Maricopa County
L.H. BELL & ASSOCIATES
5-4-62
Designed by O.R.
Drawn by G.R.
Checked by R.A.
7
ARIZ.
I-10-3(36)
11
74
Sec Cor Fnd. Brass Cap USGLO 1911
T2S R4E SEC 8
New 30" Sewer - Invert Elev. 1140.00 at R/W Line
Proposed S
Sta 929+00 "W.B." New 24" x 100' Pipe Culv C.M.P.
Lt. Sta 925+50 to Sta 944+78 1928' New 5 Wire Fence Std. C-16
Sta 937+00 "W.B" New 24" x 102' Pipe Culv 102' C.M.P.
Wit Cor 1" I.P.
P.O.T. 944+77.97
New R/W
W.B Constr ℄
Survey ℄ Median ℄
S. 33°02'46" E.
E.B. Constr ℄
B.M. 150' Rt. Med. Sta. 935+07 Iron Pipe Elev. 1146.19
B.M. 150' Rt. Med. Sta. 940+00 2"x2" Stake Elev. 1149.10
Rt. Sta. 927+00 to 944+78 1,778' New 5 Wire Fence Std. C-16
B.M. 150' Rt. Sta. 944+35.15 Brass Cap. Elev. 1144.57
Wit Cor Brass Cap
Brass Cap USGLO 1911
Brass Cap Elev. 1145.57
Sta 926+56.84 Med. ℄ 408' New 30" R.G.R.C.P. Slope = 0.00076'/ft. West
Sta 929+00 "E.B." New 24" x 116' Pipe Culv 122' C.M.P.
Sta 937+00 "E.B." New 24" x 110' Pipe Culv 102' C.M.P.
B.M. 135' Rt. Med. Sta. 930+00 1"x2" Stake, Elev. 1144.14
B.M. 93 192' Rt. ℄ Sta 925+32 BR. Cap, USGLO 1/16 S5/S8, 1911 - Elev. 1148.12
B.M. 150' Rt. Med. Sta. 927+00 Brass Cap Elev. 1145.57
B.M. 94 150' Rt. ℄ Sta 935+07 5/8" I.P. & Guard - Elev. 1146.19
B.M. 945 150' Rt. ℄ Sta 945+00 5/8" I.P. & Guard - Elev. 1144.19
Rev. B.L.P. 10-15-65
No D.A.
2-38' ROADWAYS
42,302.8 C.Y. Borrow from Area 1 - 2200' Rt. - Sta. 946+00
Future W.B. Finished ℄ Grade
-0.0751 %
+0.0668 %
Exist. Ground Line
Elev. 1150.00
WESTBOUND PROFILE
Excav. 741.8
15% shrinkage 111.3
Borrow 42,302.8
20% shrinkage 8,460.6
Emb. 51,382.7
Ord. Comp. 3,090.0
Future E.B. Finished ℄ Grade
-0.0759 %
+0.0668 %
Elev. 1150.00
EASTBOUND PROFILE
Sta 930+00 1149.00 No V.C.
1150
1140
925 26 27 28 29 930 31 32 33 34 35 36 37 38 39 940 41 42 43 44
REDUCED SIZE DO NOT SCALE
7 I-10-3(36) 11 OF 74
REDUCED SIZE

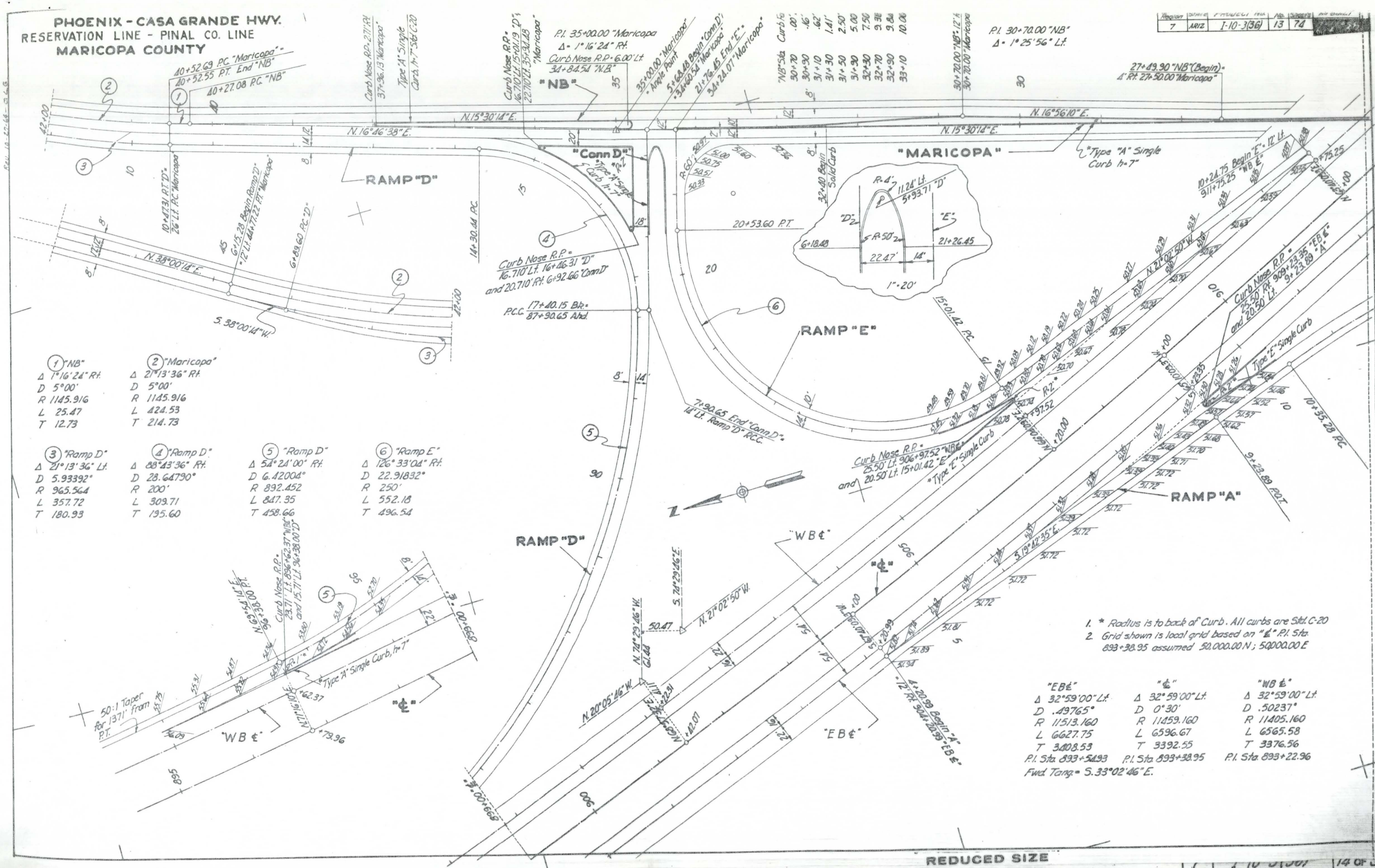
PHOENIX - CASA GRANDE HWY.
RESERVATION LINE - PINAL CO. LINE
MARICOPA COUNTY

Dist. Region	STATE	PROJECT NO.	Sheet No.	Total Sheets	AS BUILT
7	ARIZ	I-10-3(36)	12	74	

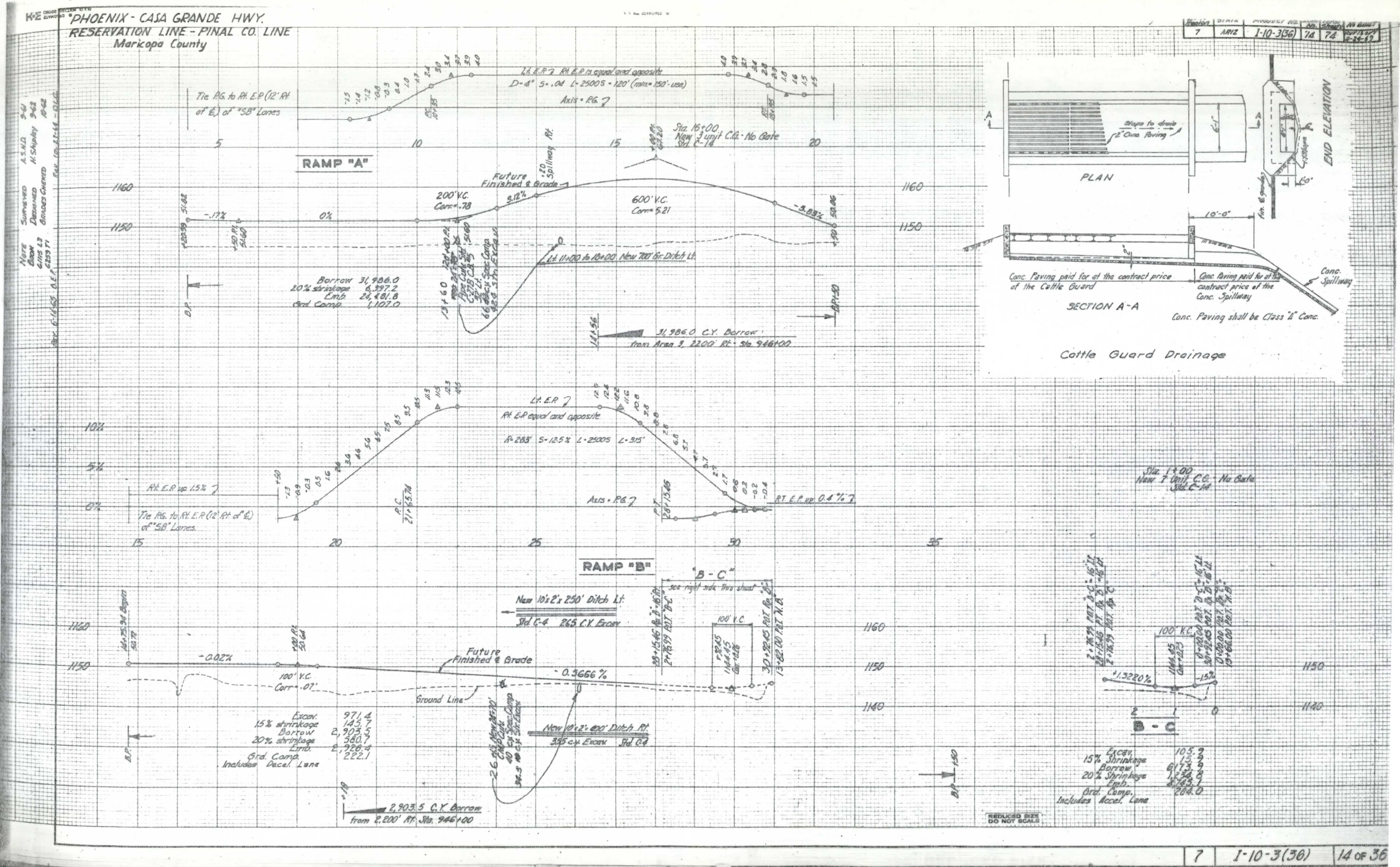


1. "Radius is to back of curb
2. Note: Grid shown is local grid based on "℄" P.I. Sta. 893+38.95 assumed 50,000.00 N.; 50,000.00 E.

REDUCED SIZE



PHOENIX - CASA GRANDE HWY.
RESERVATION LINE - PINAL CO. LINE
MARICOPA COUNTY
Region 7
State ARIZ
Project I-10-3(36)
13 74
RAMP "D"
RAMP "E"
RAMP "A"
"MARICOPA"
"NB"
"Conn D"
"WB ℄"
"EB ℄"
"℄"
N.15°30'14"E.
N.16°56'10"E.
N.16°46'38"E.
N.38°00'14"E.
S. 38°00'14"W.
N. 21°02'50"W.
S. 19°42'35"E.
P.I. 35+00.00 "Maricopa"
Δ = 1°16'24" Rt.
P.I. 30+70.00 "NB"
Δ = 1°25'56" Lt.
27+49.30 "NB" (Begin) = 4' Rt. 27+50.00 "Maricopa"
Curb Nose R.P. = 6.00' Lt. 34+84.54 "N.B."
20+53.60 P.T.
14+30.44 P.C.
P.C.C. 17+40.15 Bk. = 87+90.65 Ahd.
7+90.65 End "Conn D" = 14' Lt. Ramp "D" P.C.C.
Curb Nose R.P. = 16.710' Lt. 16+46.31 "D" and 20.710' Rt. 6+92.66 "Conn D"
Curb Nose R.P. = 25.50' Lt. 906+97.52 "WB ℄" and 20.50' Lt. 15+01.42 "E"
Curb Nose R.P. = 25.50' Rt. 909+23.35 "EB ℄" and 20.50' Lt. 9+23.89 "A"
"Type 'A' Single Curb h=7"
"Type 'E' Single Curb"
50:1 Taper for 1371' from P.T.
1 "NB"
Δ 1°16'24" Rt.
D 5°00'
R 1145.916
L 25.47
T 12.73
2 "Maricopa"
Δ 21°13'36" Rt.
D 5°00'
R 1145.916
L 424.53
T 214.73
3 "Ramp D"
Δ 21°13'36" Lt.
D 5.93392°
R 965.564
L 357.72
T 180.93
4 "Ramp D"
Δ 88°43'36" Rt.
D 28.64790°
R 200'
L 309.71
T 195.60
5 "Ramp D"
Δ 54°24'00" Rt.
D 6.42004°
R 892.452
L 847.35
T 458.66
6 "Ramp E"
Δ 126°33'04" Rt.
D 22.91832°
R 250'
L 552.18
T 496.54
1. * Radius is to back of Curb. All curbs are Std. C-20
2. Grid shown is local grid based on "℄" P.I. Sta. 893+38.95 assumed 50,000.00 N; 50,000.00 E
"EB ℄"
Δ 32°59'00" Lt.
D .49765°
R 11513.160
L 6627.75
T 3408.53
P.I. Sta. 893+54.93
"℄"
Δ 32°59'00" Lt.
D 0°30'
R 11459.160
L 6596.67
T 3392.55
P.I. Sta. 893+38.95
"WB ℄"
Δ 32°59'00" Lt.
D .50237°
R 11405.160
L 6565.58
T 3376.56
P.I. Sta. 893+22.96
Fwd. Tang. = S. 33°02'46" E.
REDUCED SIZE


"PHOENIX - CASA GRANDE HWY."
RESERVATION LINE - PINAL CO. LINE
Maricopa County
7 | ARIZ | I-10-3(36) | 14 | 74
Tie P.G. to Rt. E.P. (12' Rt. of ℄) of "SB" Lanes
Lt. E.P. Rt. E.P. is equal and opposite
D-4° S-.04 L-250 S-120' (min=150'-use)
Axis = P.G.
Sta. 16+00
New 3 unit C.G. - No Gate
Std. C-14
RAMP "A"
Future Finished ℄ Grade
200' V.C. Corr.=.78
600' V.C. Corr.=5.21
0%
-.17%
-3.83%
Lt. 11+00 to 16+00 New 700' Gr. Ditch Lt.
Borrow 31,986.0
20% shrinkage 6,397.2
Emb. 24,481.8
Grd. Comp. 1,107.0
31,986.0 C.Y. Borrow
from Area 3, 2200' Rt. - Sta. 946+00
B.P.
PLAN
Slope to drain
2" Conc. Paving
END ELEVATION
SECTION A-A
Conc. Paving paid for at the contract price of the Cattle Guard
Conc. Paving paid for at the contract price of the Conc. Spillway
Conc. Spillway
Conc. Paving shall be Class "B" Conc.
Cattle Guard Drainage
Lt. E.P.
Rt. E.P. equal and opposite
R-283' S-12.5% L-250 S L-315'
Rt. E.P. up 1.5%
Tie P.G. to Rt. E.P. (12' Rt. of ℄) of "SB" Lanes
Axis = P.G.
RT. E.P. up 0.4%
Sta. 1+00
New 7 Unit C.G. - No Gate
Std. C-14
RAMP "B"
"B - C"
see right side this sheet
New 10'x2'x 250' Ditch Lt.
Std. C-4 265 C.Y. Excav.
Future Finished ℄ Grade
-0.02%
100' V.C. Corr.=.07'
- 0.3666 %
Ground Line
100' V.C.
Excav. 971.4
15% shrinkage 145.7
Borrow 2,903.5
20% shrinkage 580.7
Emb. 2,926.4
Grd. Comp. 222.1
Includes Decel. Lane
New 10'x2'x 400' Ditch Rt.
355 c.y. Excav. Std. C-4
2,903.5 C.Y. Borrow
from 2,200' Rt. Sta. 946+00
+1.3220%
-1.5%
B - C
Excav. 105.9
15% Shrinkage 15.9
Borrow 6,173.9
20% Shrinkage 1,234.8
Emb. 5,143.1
Grd. Comp. 284.0
Includes Accel. Lane
REDUCED SIZE DO NOT SCALE
7 | I-10-3(36) | 14 OF 36

APR Project	STATE	PROJECT NO.	Sheet No.	Total Sheets	AS BUILT
7	ARIZ	I-10-3(36)	15	74	

PHOENIX - CASA GRANDE HWY.
RESERVATION LINE - PINAL CO. LINE
Maricopa County

RAMP "C"

Axis = P.G. 7

Rt. E.P. is equal and opposite
D=6° S=.12 L=2500 S=.300'

Lt. E.P. 7

24+16.99 P.O.T.

"B-C"
Sta. 0+00 P.O.T. on "B"
Sta. 1+00 P.O.T. Equal to "C" at Sta. 14
100' V.C.
1144.32 Corr=0.36

+1.3800%
-0.1296%
-0.01%
+0.25 P.I. 22.64
No V.C.
Future Finished & Grade
-1.5%
1147.84 Corr=2.56
200' V.C.

Excav.	766.8
15% shrinkage	115.0
Borrow	3,945.8
20% shrinkage	789.2
Emb.	3,403.4
Grd. Comp.	3,405.0

3,945.8 C.Y. Borrow
from 2,200' Rt. Sta. 946+00
Includes Accel. Lane

RAMP "E"

Tie P.G. to Lt. E.P. (12' Lt. of "E") of "NB" Lanes

Axis = P.G. 7
Sta. 19+70
New 3 unit C.B. - No Gate
Std. C-14

Lt. E.P. Rt. E.P. equal and opposite
S=.125 L=2500 S=.315'

+24.75-1.42% Alt. 24+75.25 "NBE"
Future Finished & Grade
-0.04%
100' V.C. Corr=.19'
+1.55%
Sta. 19+65.45 End of Harrison "E"

Excav.	1540
15% shrinkage	231
Drainage	6.0
15% shrinkage	0.9
Borrow	5,667.4
20% shrinkage	1,129.5
Emb.	3,807.9
Grd. Comp.	846.0

5,667.4 C.Y. Borrow
From Area 3, 2200 Rt. Sta. 946+00

RAMP "D"

Rt. E.P. 7
Lt. E.P. equal and opposite
D=5.9° use .08 Super

Sta. 17+40
New 3 unit C.B. - No Gate
Std. C-14

R=200'
use S=.08

Tie P.G. to P.G. of "Conn D" on Lt.
16+60 to 17+40

Axis = P.G. 7
D=6.5° S (use .08) L=2500 S=.200' (use .210')

Struct. & Drainage	456.0
15% shrinkage	68.4
Borrow	20,252.3
20% shrinkage	4,050.5
Emb.	14,762.4
Grd. Comp.	1,827.0

Includes Road Connection

20,252.3 C.Y. Borrow
From Area 3, 2200 Rt. Sta. 946+00

RAMP "D"

Future Finished & Grade
+.30%
200' V.C. Corr=.16'
+.87%
+.68%
200' V.C. Corr=.10'
New 10:2:400' Ditch Lt., Std. C-4
355 cy Excav.
New 2'-6"x5' Conc. lined Dt.
3920 cy Emb.

70' Rt. Sta. 91+75
New 24"x42" Pipe Culv. Sqpitwn Std. C-9
20 cy Str. Excav.
20 cy Dr. Excav.
1.64 cy Class A Conc.
73 lbs reinf. steel
Sta. 92+00
New 24"x70' Pipe Culv.
5 cy Str. Excav.
30 cy Spec. Comp.

"CONN D"

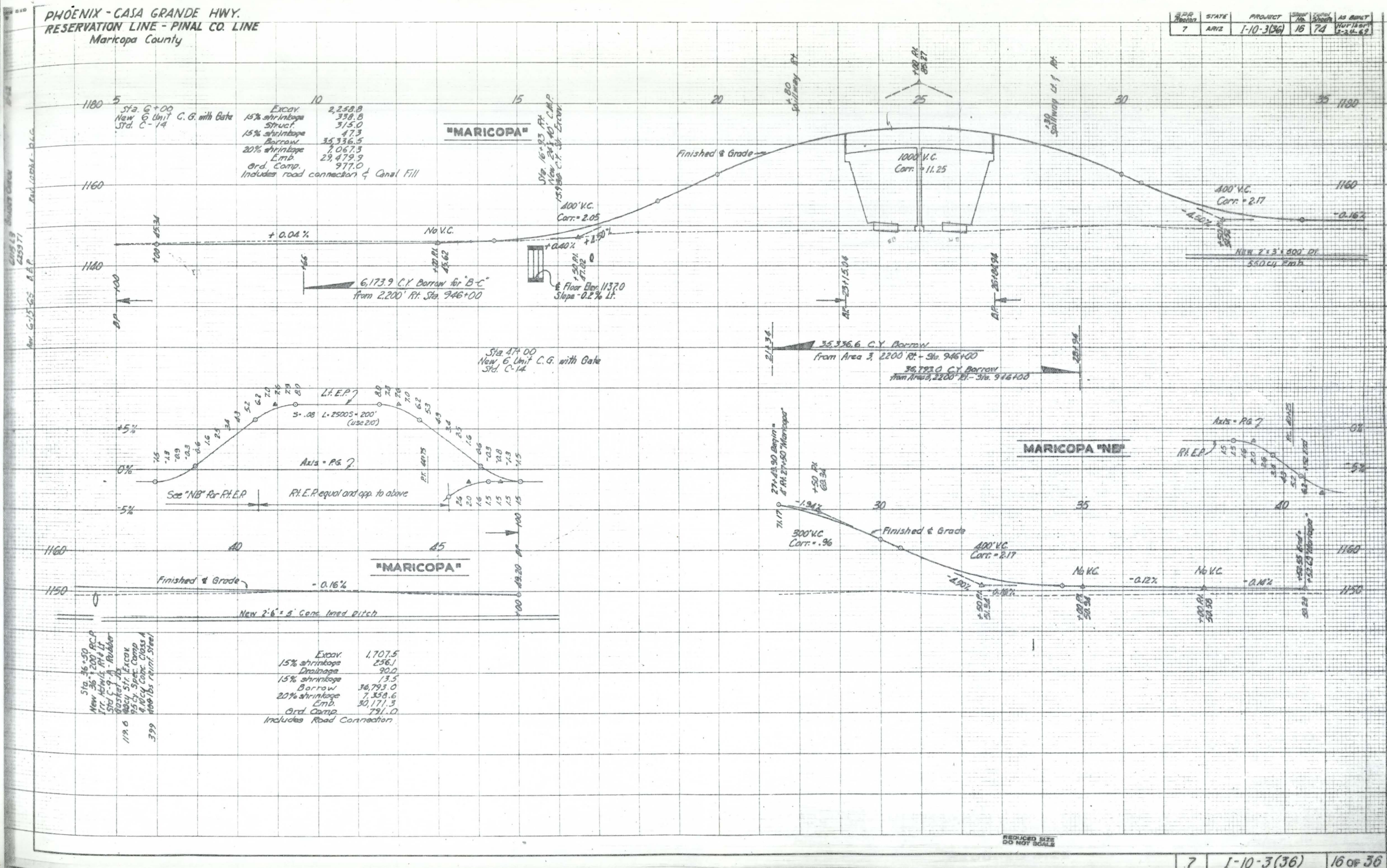
Axis = P.G. 7
The P.G. to P.G. of "Ramp D" on Rt.
Rt. E.P.

Future Finished Grade
50' V.C. Corr=.14'
+.74%
-1.53%
Sta. 7+94.65 End "Conn D" at P.C.C. Ramp D

Borrow	760.5
20% shrink	158.1
Emb.	801.4
Ord. Comp.	107.0

760.5 C.Y. Borrow
From Area 3 - 2200' Rt. - Sta. 946+00

REDUCED SIZE



PHOENIX - CASA GRANDE HWY.
RESERVATION LINE - PINAL CO. LINE
Maricopa County
7 | ARIZ | I-10-3(36) | 16 | 74
"MARICOPA"
Sta. 6+00
New 6 Unit C.G. with Gate
Std. C-14
Excav. 2,258.8
15% shrinkage 338.8
Struct. 315.0
15% shrinkage 47.3
Borrow 35,336.5
20% shrinkage 7,067.3
Emb. 29,479.9
Grd. Comp. 977.0
Includes road connection & Canal Fill
Finished ℄ Grade
1000' V.C.
Corr. = 11.25
400' V.C.
Corr. = 2.05
400' V.C.
Corr. = 2.17
+ 0.04 %
No V.C.
+0.40%
+ 4.50%
- 4.50%
- 0.16%
6,173.9 C.Y. Borrow for "B-C"
from 2,200' Rt. Sta. 946+00
℄ Floor Elev. 1137.0
Slope -0.2 % Lt.
New 2'x3'x 500' Pit
550 Cu. Emb.
35,336.6 C.Y. Borrow
from Area 3, 2200' Rt. - Sta. 946+00
36,793.0 C.Y. Borrow
from Area 3, 2200' Rt. - Sta. 946+00
Sta. 47+00
New 6 Unit C.G. with Gate
Std. C-14
Lt. E.P.
S = .08 L = 2500S = 200' (use 210')
Axis = P.G.
See "NB" for Rt. E.P.
Rt. E.P. equal and opp. to above
"MARICOPA"
Finished ℄ Grade
- 0.16%
New 2'-6" x 5' Conc. lined Ditch
Excav. 1,707.5
15% shrinkage 256.1
Drainage 90.0
15% shrinkage 13.5
Borrow 36,793.0
20% shrinkage 7,358.6
Emb. 30,171.3
Grd. Comp. 791.0
Includes Road Connection
MARICOPA "NE"
Axis = P.G.
Rt. E.P.
-1.94%
300' V.C.
Corr. = .96
Finished ℄ Grade
400' V.C.
Corr. = 2.17
- 4.90%
No V.C.
- 0.12%
No V.C.
- 0.14%
REDUCED SIZE DO NOT SCALE
7 | I-10-3(36) | 16 OF 36

B.P.R. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
7	ARIZ.	I-10-3(36)	17	74	

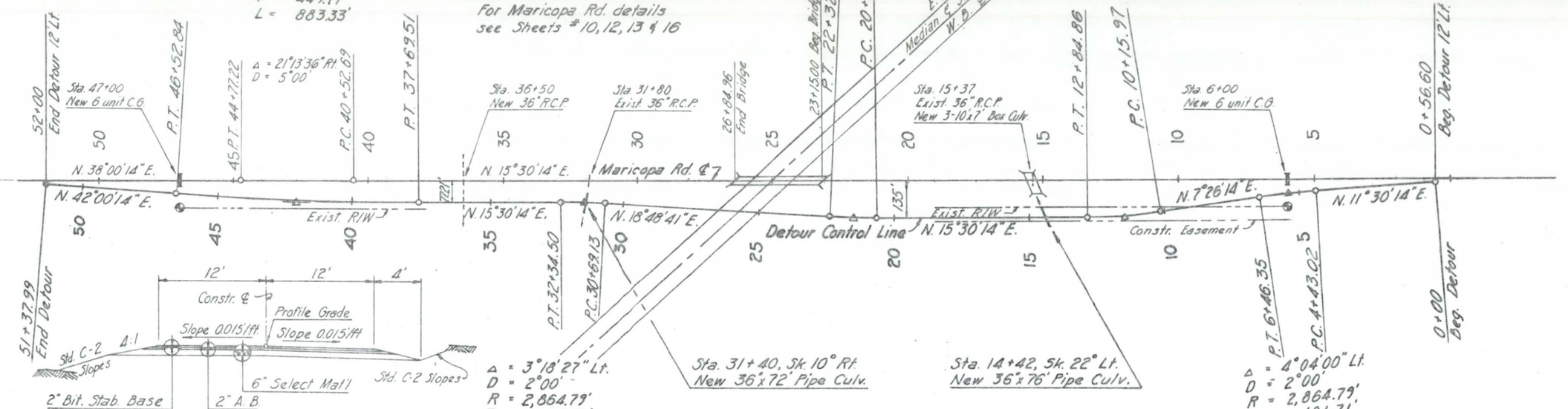
PHOENIX - CASA GRANDE HWY.
RESERVATION LINE - PINAL CO. LINE
MARICOPA COUNTY

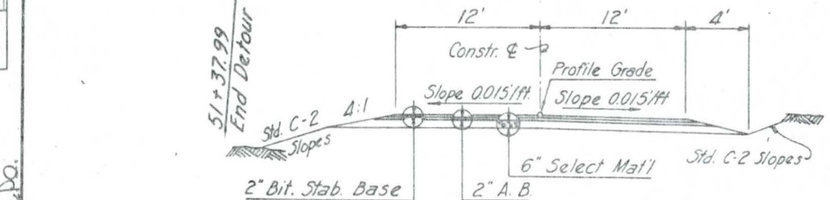
Δ = 26°30'00" Rt.
D = 3°00'
R = 1,909.86'
T = 449.71'
L = 883.33'

NOTE: For Maricopa Rd. details see Sheets # 10, 12, 13 & 16

Δ = 3°18'27" Rt.
D = 2°00'
R = 2,864.79'
T = 82.70'
L = 165.37'

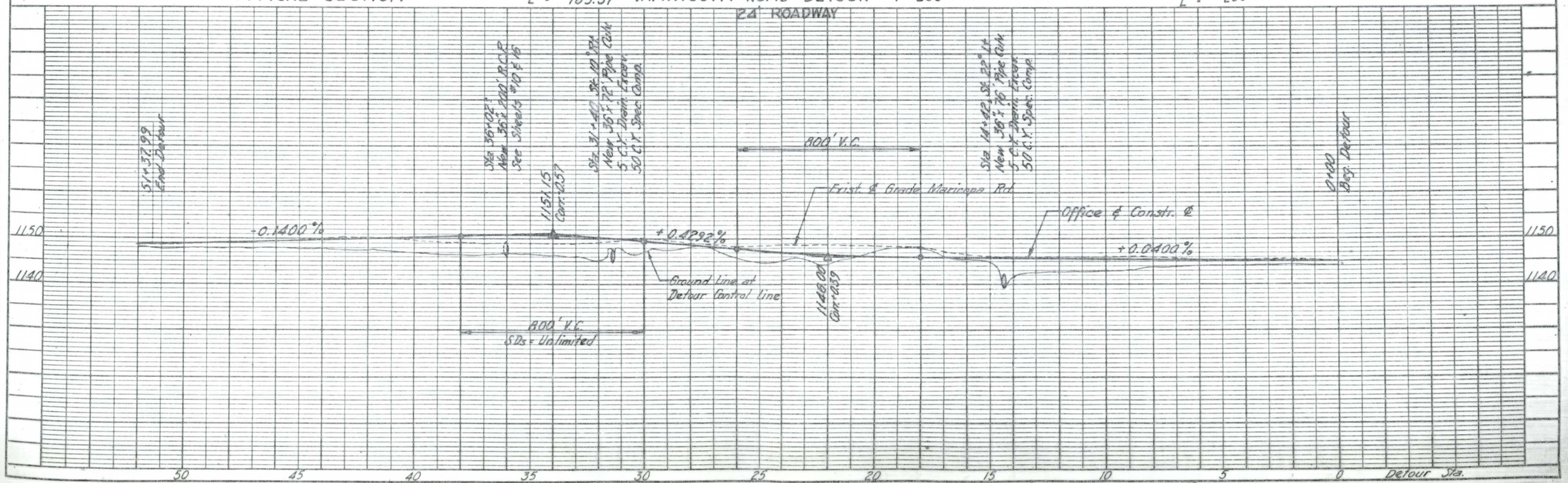
Δ = 8°04'00" Rt.
D = 3°00'
R = 1,909.86'
T = 134.67'
L = 268.89'





TYPICAL SECTION

MARICOPA ROAD DETOUR 1" = 200'



REDUCED SIZE

PHOENIX - CASA GRANDE HWY.
RESERVATION LINE - PINAL CO. LINE
MARICOPA COUNTY

REGION	STATE	PROJ. NO.	SHEETS NO.	SHEETS TOTAL	AS BUILT
7	Ariz.	I-10-3(36)	18	74	Hurt Dept 2-24-64

BENHAM ENGINEERING COMPANY INC.
PHOENIX ARIZONA
2/18/63 DATE — Chester J. McCoy CONSULTING ENGINEER
DESIGN: W.C. DRAWN: C.B.&G.S. CHECKED: C.Mc.

Rev. 3-20-63 D.B.C.
Rev. 10-16-63 B.B.P.
Rev. 12-13-63 J.D.

PLAN — NOTE BOOK: AS NOTED; GRADES CHECKED: AS NOTED; STRUCTURE QUANTITIES CHECKED: AS SHOWN; DRAWN: A.N.S.; TRACED: Anderson Engineering Co. Inc.; CHECKED: Anderson Engineering Co. Inc.; QUANTITIES CHECKED: AS SHOWN; DESIGN CHECKED: AS NOTED; STRUCTURE QUANTITIES CHECKED: AS SHOWN

N

S.33°02'46"E.

POT 942+30.64 1/16 Line

1/16 Cor. Fnd. U.S.G.L.O. Brass Cap

365.91'

237.15

POT "A" 944+77.97

945

POT 946+66.31 Sec. Line

POT "B" 949+45.01 Brass Cap in Conc.

950

West Bound Const ℄

Survey ℄ ℄ Median ℄

East Bound Const ℄

53' 52' 53' 54'

S.32°59'42"E.

BEARING EQUATION:
S.33°02'46"E. Bk. =
S.32°59'42"E.

N.89°49'32"E. Bk.
N.89°52'36"E. Ahd
1322.70'

N.0°08'55"W. 1321.35'

955.44'

32°58'47"

W.B. Sta. 945+10 New 30"X106' Pipe Culv. C.M.P.

E.B. Sta. 945+10 New 30"X106" Pipe Culv. 108' C.M.P.

Brass Cap Elev. 1144.51

E.B. Sta. 948+00 New 30"X108' Pipe Culv. C.M.P.

W.B. Sta. 948+00 106' C.M.P. New 30"X104' Pipe Culv.

New R/W Line

22' 96' 16' 54'

Lt. Sta. 944+77.49 to Sta. 953+00, 822 lin. ft. New 5 Wire fence Std. C-16

Rt. Sta. 944+78 to Sta. 953+00, 822 L.F. New 5 Wire fence Std. C-16

B.M. 94-150'Rt. ℄ Sta. 935+07
Iron Pin ℄ Guard Elev. 1146.19

1/16 Cor. Fnd. U.S.G.L.O. Brass Cap

B.M. 945-150'Rt. ℄ Sta. 945+00
Iron Pin ℄ Guard Elev. 1144.19

B.M. 94.9-150'Rt. Sta. 949+45.01
5/8" Iron Pin in Conc. Elev. 1144.46
B.M. Sta. 949+45.01 Brass Cap in Conc. Elev. 1145.18

1/16 Cor. Fnd. M.I.P.

T-2-S R-4-E 8 9

F.A.W. #1	Add earth dykes to Irrig. Ditch Sta 36+50 Maricopa Rd to Sta 898.	
C.O. #1	Increase Culverts.	
C.O. #2	Change source of Min. Aggr. S.M.V.A.B. to a Commercial Source.	
F.A.W. #2	Rebuild Irrig. Ditch.	
C.O. #3	Con. four grade Maricopa Rd T.I. Increase pipes.	
C.O. #4	Adjust piling quantities.	
C.O. #5	Purchase pile cut offs.	
C.O. #6	Change Guard Rail.	
C.O. #7	Change Delineators.	
C.O. #8	Line Irrig. Ditch along Maricopa Rd. Change Specs for Min. Aggr. Increase S.M., A.B. & Liq. Asph. Increase Str. Excav. for over-20'	
F.A.W. #3	Add mesh reinf. to ditch on Maricopa Rd. Pay for Shotcrete Liner.	
C.O. #9	Raise grade 18" Sta 1100 to 1241 Add 3 more Boxes at Sta 1127 1202 & 1240.	
C.O. #10	Increase Str. Excav. Increase Precl. Mortar.	
FAW #4	Clear & Grub area of C.O. #9 Haul Spec. Comp. around Pipes. Plug pipe Sta 1100 R-L Sub Rd T.I.	
FAW #5	Lower Subgrade 6" Sta. 879 to 882	
C.O. #11	Change Specs. for Course Aggr.	
C.O. #12	Clean up C.O.	
C.O. #13	Purchase Delineators.	

W.B. & E.B. 38' Roadway

W.B. Sta. 945+90 New 10'X2'X30' Dyke Type #3 Std. C-2 3.4 C.Y. Embankment Bar.

W.B. Sta. 948+00 New 30"X108' Pipe Culv. C.M.P. E. 44.8 Lt. E. 44.47 Rt. 48 C.Y. Struct. Excav. 48 C.Y. Spec. Comp.

New 300' Grader Ditch Lt.

New 200' Gr. Ditch Lt.

+77.97 Fin. ℄ Grade Elev. 1150.00

Finished ℄ Grade West Bound

Future

+0.0668%

1150.55

25.749 C.Y.
2200 Ft. 3 in 948+00

Existing Ground

E.B. & W.B. Excav. Bar. 25,749.1 20% Swl. 5,149.8 Emb. 17,943.9 Sub Comp. 2,856.0 Incls. Dyke

+77.97 Fin. ℄ Grade Elev. 1150.00

Finished ℄ Grade East Bound

Future

+0.0668%

1150.55

B.P. 17.72

Existing Ground

E.B. Sta. 945+10 New 30"X106" Pipe Culv. 108' C.M.P. E. 44.4 Lt. E. 44.4 Rt. 18 C.Y. Struct. Excav. 34 C.Y. Spec. Comp.

E.B. Sta. 948+00 New 30"X108" Pipe Culv. C.M.P. E. 44.9 Lt. E. 44.4 Rt. 22 C.Y. Struct. Excav. 46 C.Y. Spec. Comp.

940 1 2 3 4 945 6 7 8 9 950 1 2 3

REDUCED SIZE DO NOT SCALE

PLATE I. PLAN-PROFILE U.P.R.R.E.E. STANDARD

7	I-10-3(36)	18	OF 36

PHOENIX-CASA GRANDE HWY.
RESERVATION LINE - PINAL CO. LINE
MARICOPA COUNTY

F.A.P. REGION	STATE	PROJ. NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
7	Ariz.	I-10-3(36)	19	74	Nov 1969

BENHAM ENGINEERING COMPANY INC.
PHOENIX ARIZONA
8/12/69 DATE — CONSULTING ENGINEER
DESIGN: W.C. DRAWN: C.B.&D.S. CHECKED: C. Mc.

Registered Professional Engineer — Certificate Expires — Wilson D. Ghio — Dec. 31, 1969 — Arizona U.S.A.

W.B. Sta. 959+00
New 30"X104' ~~Pipe Culv.~~
C. M. P.

POT 958+05.75
¼ Line, Iron Pin

Fnd. I.P.

Lt. Sta. 953+00 to Sta. 983+00
3000 Lin. ft. of New 5 Wire Fence
Std. C-16

N.0°03'09"E.
1318.71'

POT 970+91.57
⅛ Line, Iron Pin

Brass Cap
Elev. 1150.70

POT 973+78.10
⅛ Line, Iron Pin

1319.46'
N.89°56'42"E.

POT "C" 976+68.97
Brass Cap in Conc.

Fnd. I.P.

955 960 965 970 975 980

W.B. Sta. 954+25
New 30"X~~98'~~ ~~Pipe Culv.~~
102' C.M.P.

W.B. Sta. 964+00
New 30"X104' ~~Pipe Culv.~~
108' C.M.P.

New R/W Line

West Bound Const. ℄

No Access

56°59'02"

101.24'

57°03'36"

96' 22' 54' 16' 49' 50' 52' 53' Survey ℄ S.32°59'42"E. Median ℄

East Bound Const. ℄

240.47'

156.23'

No Access

E.B. Sta. 954+25
New 30"X102' ~~Pipe Culv.~~
C. M. P.

321.48'
S.89°56'44"E.

E.B. Sta. 959+00
New 30"X108' ~~Pipe Culv.~~
C. M. P.

E.B. Sta. 964+00
New 30"X108' ~~Pipe Culv.~~
C. M. P.

New R/W Line — ⅛ Cor.
Brass Cap Elev. 1150.08
Fd. Rusted Pipe - No Cap 5" Below Ground.

Rt. Sta. 953+00 to Sta. 983+00
3000 Lin. ft. New 5 Wire Fence
Std. C-16

B.M. 150' Rt. Med. Sta. 953+00
2"x 2" Stake Elev. 1145.12

B.M. 150' Rt. Med. Sta. 965+00
2"x 2" Stake Elev. 1146.05

1319.47'
N.0°03'49"E

B.M. 148' Rt. Med. Sta. 982+00
2"x 2" Stake Elev. 1148.03.

955.44' to ℄
N.0°00'55"W.

T.2S. - R.4E.

¼ Cor.
Fnd. 1" I.P.

B.M. 96-150' Rt. Sta. 960+88.87
5/8" Iron Pin in Conc. Elev. 1145.55.48

B.M. 97-150' Rt. Sta. 970+80
5/8" Iron Pin in Conc. Elev. 1149.84

1320.23'
N.89°55'10"E

⅛ Cor.
Fnd. I.P.

B.M. 97.7-150' Rt. Sta. 976+68.97
5/8" Iron Pin in Conc. Elev. 1150.03
~~B.M. Station 976+68.97 Brass Cap in Conc. Elev. 1151.21~~

⅛ Cor.
Fnd. I.P.

W.B. Sta. 954+00
New 10'X2'X30' Dyke
Type 21' Std. C-4
30 C.Y. Emb. from Bor.
+0.0668 %
1150.55
1160 1150 1140

W.B. Sta. 954+25
New 30"X~~98'~~ ~~Pipe Culv.~~
102' C.M.P.
E. 456 Lt.
E. 458 Lt. 102' C.M.P.
E. 457 Rt.
#8 C.Y. Struct. Excav.
45 C.Y. Spec. Comp.
+100
P.I. El. 1150.68
No V.C.

W.B. Sta. 959+00
New 30"X108' ~~Pipe Culv.~~
C.M.P.
E. 457 Lt.
E. 456 Rt.
#8 C.Y. Struct. Excav.
49 C.Y. Spec. Comp.
+0.1117 %

W.B. Sta. 964+00
New 30"X108' ~~Pipe Culv.~~
C.M.P.
E. 463 Lt. 108' C.M.P.
E. 462 Rt.
#8 C.Y. Struct. Excav.
49 C.Y. Spec. Comp.
+100
P.I. El. 1152.08
No V.C.

W.B. & E.B.
38' Roadway

New 900' Grader Ditch Lt.

New 850' Grader Ditch Lt.

+0.0797 %
Finished ℄ Grade West Bound Future
Exist. Ground

E.B. & W.B.
Excav
Bor. 38,419.5
20% Shr. 7,683.9
Emb. 27,335.6
Grd comp. 3,380.0
Incls Dyke

New 10'X2'X36' Dyke
Type 21' Std. C-4
35 C.Y. Emb. from Bor.

38,419.5 cy Bor From Pit
1900 Rt. Sta 967+00

+0.0668 %
1150.55

E.B. Sta. 954+25
New 30"X~~102'~~ ~~Pipe Culv.~~
C.M.P.
E. 456 Lt.
E. 455 Rt.
#8 C.Y. Struct. Excav.
47 C.Y. Spec. Comp.
+100
P.I. El. 1150.68
No V.C.

E.B. Sta. 959+00
New 30"X108' ~~Pipe Culv.~~
C.M.P.
E. 454 Lt.
E. 453 Rt.
#8 C.Y. Struct. Excav.
52 C.Y. Spec. Comp.

E.B. Sta. 964+00
New 30"X108' ~~Pipe Culv.~~
C.M.P.
E. 461 Lt.
E. 460 Rt.
#8 C.Y. Struct. Excav.
52 C.Y. Spec. Comp.

New 10'X2'X96' Dyke
Type 21' Std. C-4
24 C.Y. Emb. from Bor.

+100
P.I. El. 1152.08
No V.C.

+0.0797 %
Finished ℄ Grade East Bound Future
Exist. Ground

E.B. ℄ W.B.
Excav 4.2
15% Shr. 0.6
Bor. 30,889.4
20% Shr. 6,177.9
Emb. 19,024.1
Grd. Comp. 3,691.0
Incls Dyke

30,889.4 cy Bor From Pit 1900' Rt.
Sta. 967+00

E.B. ℄

1153.30

1160 1150 1140

955 960 965 970 975 980

PLATE 1 - PLAN PROFILE - U.S.B.P.R. & B.E. STANDARD

7 | I-10-3(36) | 19 OF 36

GILA DRAIN PROJECT

COST ESTIMATES FOR PARTIAL SOLUTIONS TO GILA DRAIN PROBLEM

MARICOPA COUNTY FLOOD CONTROL DISTRICT

COMBINATIONS OF PARTIAL SOLUTIONS TO GILA DRAIN PROBLEM

SUMMARY

SOLUTION	OPTIONS	COST
12	A1 C D E1 F	4898000.
23	A0 D E1 F I K6	5031000.
1	A2 D E0 F H1 I	5336000.
6	A1 D E1 F I	5473000.
2	A2 D E0 G H2 I	5540000.
3	A2 D E0 F H1 I J2	5726000.
7	A1 C D E0 F H1	5740000.
4	A2 D E0 G H2 I J2	5930000.
8	A1 C D E0 G H2	5944000.
9	A1 C D E0 F H1 J2	6130000.
20	A0 D E0 F H1 I J2 K6	6263000.
16	A0 D E0 F H1 I K5	6265000.
10	A1 C D E0 G H2 J2	6334000.
21	A0 D E0 G H2 I J2 K6	6467000.
17	A0 D E0 G H2 I K5	6469000.
5	A2 D E1 F I J1	6678000.
13	A0 C D E0 F H1 J2 K4	6811000.
25	A0 C D E0 F H1 K3	6813000.
14	A0 C D E0 G H2 J2 K4	7015000.
24	A0 C D E0 G H2 K3	7017000.
11	A1 C D E1 F J1	7082000.
22	A0 D E1 F I J1 K6	7215000.
18	A0 D E1 F I K2	7226000.
15	A0 C D E1 F J1 K4	7763000.
19	A0 C D E1 F K1	7775000.

Gila Drain

MARICOPA COUNTY FLOOD CONTROL DISTRICT

COMBINATIONS OF PARTIAL SOLUTIONS TO GILA DRAIN PROBLEM

	CONSTRUCTION ITEM	COST
A0	NO CHANNEL THROUGH RESERVATION	0000.
A1	CHANNEL PECOS RD TO GILA WITH I-10 CULVERT (Q=4300)	1853000.
A2	CHANNEL PECOS RD TO GILA, NO I-10 CULVERT (Q=2000)	874000.
C	CHANNEL ERYE TO PECOS (200 CFS)	543000.
D	CHANNEL WESTERN CANAL TO PECOS RD (Q=700)	870000.
E0	USE OF WESTERN CANAL FROM GILBERT	0000.
E1	CHANNEL ALONG WESTERN CANAL (Q=700)	952000.
F	GILBERT CHANNEL AND TRAINING DIKES (Q 650)	680000.
G	RETENTION ABOVE GILBERT (V=690)	1794000.
H1	RETENTION BELOW GILBERT, NONE ABOVE (V=690)	1794000.
H2	RETENTION BELOW GILBERT, RETENTION ABOVE (V=340)	884000.
I	RETENTION IN CHANDLER (V=430)	1118000.
J1	RETENTION AT PRICE RD, NONE IN GILBERT (V=840)	2184000.
J2	RETENTION AT PRICE RD, RETENTION IN GILBERT (V=150)	390000.
K1	RETENTION AT PECOS W/NO RETENTION ABOVE (V=1810)	4730000.
K2	RETENTION AT PECOS W/RETENTION AT CHANDLER (V=1380)	3606000.
K3	RETENTION AT PECOS W/RETENTION AT GILBERT (V=1120)	2926000.
K4	RETENTION AT PECOS W/RETENTION AT PRICE RD (V=970)	2534000.
K5	RETENTION AT PECOS W/RETENTION AT GILBERT AND CHANDLER (V=690)	1803000.
K6	RETENTION AT PECOS W/RETENTION AT PRICE RD AND CHANDLER (V=540)	1411000.

Moore Business Forms, Inc. f

MARICOPA COUNTY FLOOD CONTROL DISTRICT

COMBINATIONS OF PARTIAL SOLUTIONS TO GILA DRAIN PROBLEM

SOLUTION NUMBER 1	ITEM	COST
A2	CHANNEL PECOS RD TO GILA, NO I-10 CULVERT (Q=2000)	874000.
D	CHANNEL WESTERN CANAL TO PECOS RD (Q=700)	870000.
E0	USE OF WESTERN CANAL FROM GILBERT	0000.
F	GILBERT CHANNEL AND TRAINING DIKES (Q 650)	680000.
H1	RETENTION BELOW GILBERT, NONE ABOVE (V=690)	1794000.
I	RETENTION IN CHANDLER (V=430)	1118000.
	TOTAL	5336000.

Moore Business Forms, Inc.

MARICOPA COUNTY FLOOD CONTROL DISTRICT

COMBINATIONS OF PARTIAL SOLUTIONS TO GILA DRAIN PROBLEM

SOLUTION NUMBER 2	ITEM	COST
A2	CHANNEL PECOS RD TO GILA, NO I-10 CULVERT (Q=2000)	874000.
D	CHANNEL WESTERN CANAL TO PECOS RD (Q=700)	870000.
E0	USE OF WESTERN CANAL FROM GILBERT	0000.
G	RETENTION ABOVE GILBERT (V=690)	1794000.
H2	RETENTION BELOW GILBERT, RETENTION ABOVE (V=340)	884000.
I	RETENTION IN CHANDLER (V=430)	1118000.
	TOTAL	5540000.

Moore Business Forms, Inc.

MARICOPA COUNTY FLOOD CONTROL DISTRICT

COMBINATIONS OF PARTIAL SOLUTIONS TO GILA DRAIN PROBLEM

SOLUTION NUMBER 3	ITEM	COST
A2	CHANNEL PECOS RD TO GILA, NO I-10 CULVERT (Q=2000)	874000.
D	CHANNEL WESTERN CANAL TO PECOS RD (Q=700)	870000.
E0	USE OF WESTERN CANAL FROM GILBERT	0000.
F	GILBERT CHANNEL AND TRAINING DIKES (Q 650)	680000.
H1	RETENTION BELOW GILBERT, NONE ABOVE (V=690)	1794000.
I	RETENTION IN CHANDLER (V=430)	1118000.
J2	RETENTION AT PRICE RD, RETENTION IN GILBERT (V=150)	390000.
	TOTAL	5726000.

Moore Business Forms, Inc. f

MARICOPA COUNTY FLOOD CONTROL DISTRICT

COMBINATIONS OF PARTIAL SOLUTIONS TO GILA DRAIN PROBLEM

SOLUTION NUMBER 4	ITEM	COST
A2	CHANNEL PECOS RD TO GILA, NO I-10 CULVERT (Q=2000)	874000.
D	CHANNEL WESTERN CANAL TO PECOS RD (Q=700)	870000.
E0	USE OF WESTERN CANAL FROM GILBERT	0000.
G	RETENTION ABOVE GILBERT (V=690)	1794000.
H2	RETENTION BELOW GILBERT, RETENTION ABOVE (V=340)	884000.
I	RETENTION IN CHANDLER (V=430)	1118000.
J2	RETENTION AT PRICE RD, RETENTION IN GILBERT (V=150)	390000.
	TOTAL	5930000.

Moore Business Forms, Inc.

MARICOPA COUNTY FLOOD CONTROL DISTRICT

COMBINATIONS OF PARTIAL SOLUTIONS TO GILA DRAIN PROBLEM

SOLUTION NUMBER 5	ITEM	COST
A2	CHANNEL PECOS RD TO GILA, NO I-10 CULVERT (Q=2000)	874000.
D	CHANNEL WESTERN CANAL TO PECOS RD (Q=700)	870000.
E1	CHANNEL ALONG WESTERN CANAL (Q=700)	952000.
F	GILBERT CHANNEL AND TRAINING DIKES (Q 650)	680000.
I	RETENTION IN CHANDLER (V=430)	1118000.
J1	RETENTION AT PRICE RD, NONE IN GILBERT (V=840)	2184000.
	TOTAL	6678000.

Moore Business Forms, Inc.

MARICOPA COUNTY FLOOD CONTROL DISTRICT

COMBINATIONS OF PARTIAL SOLUTIONS TO GILA DRAIN PROBLEM

SOLUTION NUMBER 6	ITEM	COST
A1	CHANNEL PECOS RD TO GILA WITH I-10 CULVERT (Q=4300)	1853000.
D	CHANNEL WESTERN CANAL TO PECOS RD (Q=700)	870000.
E1	CHANNEL ALONG WESTERN CANAL (Q=700)	952000.
F	GILBERT CHANNEL AND TRAINING DIKES (Q 650)	680000.
I	RETENTION IN CHANDLER (V=430)	1118000.
	TOTAL	5473000.

Moore Business Forms, Inc. f

MARICOPA COUNTY FLOOD CONTROL DISTRICT

COMBINATIONS OF PARTIAL SOLUTIONS TO GILA DRAIN PROBLEM

SOLUTION NUMBER 7	ITEM	COST
A1	CHANNEL PECOS RD TO GILA WITH I-10 CULVERT (Q=4300)	1853000.
C	CHANNEL ERYE TO PECOS (200 CFS)	543000.
D	CHANNEL WESTERN CANAL TO PECOS RD (Q=700)	870000.
E0	USE OF WESTERN CANAL FROM GILBERT	0000.
F	GILBERT CHANNEL AND TRAINING DIKES (Q 650)	680000.
H1	RETENTION BELOW GILBERT, NONE ABOVE (V=690)	1794000.
	TOTAL	5740000.

Moore Business Forms, Inc. f

MARICOPA COUNTY FLOOD CONTROL DISTRICT

COMBINATIONS OF PARTIAL SOLUTIONS TO GILA DRAIN PROBLEM

SOLUTION NUMBER 8	ITEM	COST
A1	CHANNEL PECOS RD TO GILA WITH I-10 CULVERT (Q=4300)	1853000.
C	CHANNEL ERYE TO PECOS (200 CFS)	543000.
D	CHANNEL WESTERN CANAL TO PECOS RD (Q=700)	870000.
E0	USE OF WESTERN CANAL FROM GILBERT	0000.
G	RETENTION ABOVE GILBERT (V=690)	1794000.
H2	RETENTION BELOW GILBERT, RETENTION ABOVE (V=340)	884000.
	TOTAL	5944000.

Moore Business Forms, Inc. f

MARICOPA COUNTY FLOOD CONTROL DISTRICT

COMBINATIONS OF PARTIAL SOLUTIONS TO GILA DRAIN PROBLEM

SOLUTION NUMBER 9	ITEM	COST
A1	CHANNEL PECOS RD TO GILA WITH I-10 CULVERT (Q=4300)	1853000.
C	CHANNEL ERYE TO PECOS (200 CFS)	543000.
D	CHANNEL WESTERN CANAL TO PECOS RD (Q=700)	870000.
E0	USE OF WESTERN CANAL FROM GILBERT	0000.
F	GILBERT CHANNEL AND TRAINING DIKES (Q 650)	680000.
H1	RETENTION BELOW GILBERT, NONE ABOVE (V=690)	1794000.
J2	RETENTION AT PRICE RD, RETENTION IN GILBERT (V=150)	390000.
	TOTAL	6130000.

Moore Business Forms, Inc. f

MARICOPA COUNTY FLOOD CONTROL DISTRICT

COMBINATIONS OF PARTIAL SOLUTIONS TO GILA DRAIN PROBLEM

SOLUTION NUMBER 10	ITEM	COST
A1	CHANNEL PECOS RD TO GILA WITH I-10 CULVERT (Q=4300)	1853000.
C	CHANNEL ERYE TO PECOS (200 CFS)	543000.
D	CHANNEL WESTERN CANAL TO PECOS RD (Q=700)	870000.
E0	USE OF WESTERN CANAL FROM GILBERT	0000.
G	RETENTION ABOVE GILBERT (V=690)	1794000.
H2	RETENTION BELOW GILBERT, RETENTION ABOVE (V=340)	884000.
J2	RETENTION AT PRICE RD, RETENTION IN GILBERT (V=150)	390000.
	TOTAL	6334000.

Moore Business Forms, Inc.

MARICOPA COUNTY FLOOD CONTROL DISTRICT

COMBINATIONS OF PARTIAL SOLUTIONS TO GILA DRAIN PROBLEM

SOLUTION NUMBER 11	ITEM	COST
A1	CHANNEL PECOS RD TO GILA WITH I-10 CULVERT (Q=4300)	1853000.
C	CHANNEL ERYE TO PECOS (200 CFS)	543000.
D	CHANNEL WESTERN CANAL TO PECOS RD (Q=700)	870000.
E1	CHANNEL ALONG WESTERN CANAL (Q=700)	952000.
F	GILBERT CHANNEL AND TRAINING DIKES (Q 650)	680000.
J1	RETENTION AT PRICE RD, NONE IN GILBERT (V=840)	2184000.
	TOTAL	7082000.

Moore Business Forms, Inc. f

MARICOPA COUNTY FLOOD CONTROL DISTRICT

COMBINATIONS OF PARTIAL SOLUTIONS TO GILA DRAIN PROBLEM

SOLUTION NUMBER 12	ITEM	COST
A1	CHANNEL PECOS RD TO GILA WITH I-10 CULVERT (Q=4300)	1853000.
C	CHANNEL ERYE TO PECOS (200 CFS)	543000.
D	CHANNEL WESTERN CANAL TO PECOS RD (Q=700)	870000.
E1	CHANNEL ALONG WESTERN CANAL (Q=700)	952000.
F	GILBERT CHANNEL AND TRAINING DIKES (Q 650)	680000.
	TOTAL	4898000.

Moore Business Forms, Inc. f

MARICOPA COUNTY FLOOD CONTROL DISTRICT

COMBINATIONS OF PARTIAL SOLUTIONS TO GILA DRAIN PROBLEM

SOLUTION NUMBER 13	ITEM	COST
A0	NO CHANNEL THROUGH RESERVATION	0000.
C	CHANNEL ERYE TO PECOS (200 CFS)	543000.
D	CHANNEL WESTERN CANAL TO PECOS RD (Q=700)	870000.
E0	USE OF WESTERN CANAL FROM GILBERT	0000.
F	GILBERT CHANNEL AND TRAINING DIKES (Q 650)	680000.
H1	RETENTION BELOW GILBERT, NONE ABOVE (V=690)	1794000.
J2	RETENTION AT PRICE RD, RETENTION IN GILBERT (V=150)	390000.
K4	RETENTION AT PECOS W/RETENTION AT PRICE RD (V=970)	2534000.
	TOTAL	6811000.

Moore Business Forms, Inc. f

MARICOPA COUNTY FLOOD CONTROL DISTRICT

COMBINATIONS OF PARTIAL SOLUTIONS TO GILA DRAIN PROBLEM

SOLUTION NUMBER 14	ITEM	COST
A0	NO CHANNEL THROUGH RESERVATION	0000.
C	CHANNEL ERYE TO PECOS (200 CFS)	543000.
D	CHANNEL WESTERN CANAL TO PECOS RD (Q=700)	870000.
E0	USE OF WESTERN CANAL FROM GILBERT	0000.
G	RETENTION ABOVE GILBERT (V=690)	1794000.
H2	RETENTION BELOW GILBERT, RETENTION ABOVE (V=340)	884000.
J2	RETENTION AT PRICE RD, RETENTION IN GILBERT (V=150)	390000.
K4	RETENTION AT PECOS W/RETENTION AT PRICE RD (V=970)	2534000.
	TOTAL	7015000.

Moore Business Forms, Inc. f

MARICOPA COUNTY FLOOD CONTROL DISTRICT

COMBINATIONS OF PARTIAL SOLUTIONS TO GILA DRAIN PROBLEM

SOLUTION NUMBER 15	ITEM	COST
A0	NO CHANNEL THROUGH RESERVATION	0000.
C	CHANNEL ERYE TO PECOS (200 CFS)	543000.
D	CHANNEL WESTERN CANAL TO PECOS RD (Q=700)	870000.
E1	CHANNEL ALONG WESTERN CANAL (Q=700)	952000.
F	GILBERT CHANNEL AND TRAINING DIKES (Q 650)	680000.
J1	RETENTION AT PRICE RD, NONE IN GILBERT (V=840)	2184000.
K4	RETENTION AT PECOS W/RETENTION AT PRICE RD (V=970)	2534000.
	TOTAL	7763000.

Moore Business Forms, Inc.

MARICOPA COUNTY FLOOD CONTROL DISTRICT

COMBINATIONS OF PARTIAL SOLUTIONS TO GILA DRAIN PROBLEM

SOLUTION NUMBER 16	ITEM	COST
A0	NO CHANNEL THROUGH RESERVATION	0000.
D	CHANNEL WESTERN CANAL TO PECOS RD (Q=700)	870000.
E0	USE OF WESTERN CANAL FROM GILBERT	0000.
F	GILBERT CHANNEL AND TRAINING DIKES (Q 650)	680000.
H1	RETENTION BELOW GILBERT, NONE ABOVE (V=690)	1794000.
I	RETENTION IN CHANDLER (V=430)	1118000.
K5	RETENTION AT PECOS W/RETENTION AT GILBERT AND CHANDLER (V=690)	1803000.
	TOTAL	6265000.

Moore Business Forms, Inc.

MARICOPA COUNTY FLOOD CONTROL DISTRICT

COMBINATIONS OF PARTIAL SOLUTIONS TO GILA DRAIN PROBLEM

SOLUTION NUMBER 17	ITEM	COST
A0	NO CHANNEL THROUGH RESERVATION	0000.
D	CHANNEL WESTERN CANAL TO PECOS RD (Q=700)	870000.
E0	USE OF WESTERN CANAL FROM GILBERT	0000.
G	RETENTION ABOVE GILBERT (V=690)	1794000.
H2	RETENTION BELOW GILBERT, RETENTION ABOVE (V=340)	884000.
I	RETENTION IN CHANDLER (V=430)	1118000.
K5	RETENTION AT PECOS W/RETENTION AT GILBERT AND CHANDLER (V=690)	1803000.
	TOTAL	6469000.

Moore Business Forms, Inc. I

MARICOPA COUNTY FLOOD CONTROL DISTRICT

COMBINATIONS OF PARTIAL SOLUTIONS TO GILA DRAIN PROBLEM

SOLUTION NUMBER 18	ITEM	COST
A0	NO CHANNEL THROUGH RESERVATION	0000.
D	CHANNEL WESTERN CANAL TO PECOS RD (Q=700)	870000.
E1	CHANNEL ALONG WESTERN CANAL (Q=700)	952000.
F	GILBERT CHANNEL AND TRAINING DIKES (Q 650)	680000.
I	RETENTION IN CHANDLER (V=430)	1118000.
K2	RETENTION AT PECOS W/RETENTION AT CHANDLER (V=1380)	3606000.
	TOTAL	7226000.

Moore Business Forms, Inc. f

MARICOPA COUNTY FLOOD CONTROL DISTRICT

COMBINATIONS OF PARTIAL SOLUTIONS TO GILA DRAIN PROBLEM

SOLUTION NUMBER 19	ITEM	COST
A0	NO CHANNEL THROUGH RESERVATION	0000.
C	CHANNEL ERYE TO PECOS (200 CFS)	543000.
D	CHANNEL WESTERN CANAL TO PECOS RD (Q=700)	870000.
E1	CHANNEL ALONG WESTERN CANAL (Q=700)	952000.
F	GILBERT CHANNEL AND TRAINING DIKES (Q 650)	680000.
K1	RETENTION AT PECOS W/NO RETENTION ABOVE (V=1810)	4730000.
	TOTAL	7775000.

Moore Business Forms, Inc.

MARICOPA COUNTY FLOOD CONTROL DISTRICT

COMBINATIONS OF PARTIAL SOLUTIONS TO GILA DRAIN PROBLEM

SOLUTION NUMBER 20	ITEM	COST
A0	NO CHANNEL THROUGH RESERVATION	0000.
D	CHANNEL WESTERN CANAL TO PECOS RD (Q=700)	870000.
E0	USE OF WESTERN CANAL FROM GILBERT	0000.
F	GILBERT CHANNEL AND TRAINING DIKES (Q 650)	680000.
H1	RETENTION BELOW GILBERT, NONE ABOVE (V=690)	1794000.
I	RETENTION IN CHANDLER (V=430)	1118000.
J2	RETENTION AT PRICE RD, RETENTION IN GILBERT (V=150)	390000.
K6	RETENTION AT PECOS W/RETENTION AT PRICE RD AND CHANDLER (V=540)	1411000.
	TOTAL	6263000.

Moore Business Forms, Inc.

MARICOPA COUNTY FLOOD CONTROL DISTRICT

COMBINATIONS OF PARTIAL SOLUTIONS TO GILA DRAIN PROBLEM

SOLUTION NUMBER 21	ITEM	COST
A0	NO CHANNEL THROUGH RESERVATION	0000.
D	CHANNEL WESTERN CANAL TO PECOS RD (Q=700)	870000.
E0	USE OF WESTERN CANAL FROM GILBERT	0000.
G	RETENTION ABOVE GILBERT (V=690)	1794000.
H2	RETENTION BELOW GILBERT, RETENTION ABOVE (V=340)	884000.
I	RETENTION IN CHANDLER (V=430)	1118000.
J2	RETENTION AT PRICE RD, RETENTION IN GILBERT (V=150)	390000.
K6	RETENTION AT PECOS W/RETENTION AT PRICE RD AND CHANDLER (V=540)	1411000.
	TOTAL	6467000.

Moore Business Forms, Inc.

MARICOPA COUNTY FLOOD CONTROL DISTRICT

COMBINATIONS OF PARTIAL SOLUTIONS TO GILA DRAIN PROBLEM

SOLUTION NUMBER 22	ITEM	COST
A0	NO CHANNEL THROUGH RESERVATION	0000.
D	CHANNEL WESTERN CANAL TO PECOS RD (Q=700)	870000.
E1	CHANNEL ALONG WESTERN CANAL (Q=700)	952000.
F	GILBERT CHANNEL AND TRAINING DIKES (Q 650)	680000.
I	RETENTION IN CHANDLER (V=430)	1118000.
J1	RETENTION AT PRICE RD, NONE IN GILBERT (V=840)	2184000.
K6	RETENTION AT PECOS W/RETENTION AT PRICE RD AND CHANDLER (V=540)	1411000.
	TOTAL	7215000.

Moore Business Forms, Inc.

MARICOPA COUNTY FLOOD CONTROL DISTRICT

COMBINATIONS OF PARTIAL SOLUTIONS TO GILA DRAIN PROBLEM

SOLUTION NUMBER 23	ITEM	COST
AO	NO CHANNEL THROUGH RESERVATION	0000.
D	CHANNEL WESTERN CANAL TO PECOS RD (Q=700)	870000.
E1	CHANNEL ALONG WESTERN CANAL (Q=700)	952000.
F	GILBERT CHANNEL AND TRAINING DIKES (Q 650)	680000.
I	RETENTION IN CHANDLER (V=430)	1118000.
K6	RETENTION AT PECOS W/RETENTION AT PRICE RD AND CHANDLER (V=540)	1411000.
	TOTAL	5031000.

Moore Business Forms, Inc. f

MARICOPA COUNTY FLOOD CONTROL DISTRICT

COMBINATIONS OF PARTIAL SOLUTIONS TO GILA DRAIN PROBLEM

SOLUTION NUMBER 24	ITEM	COST
AO	NO CHANNEL THROUGH RESERVATION	0000.
C	CHANNEL ERYE TO PECOS (200 CFS)	543000.
D	CHANNEL WESTERN CANAL TO PECOS RD (Q=700)	870000.
EO	USE OF WESTERN CANAL FROM GILBERT	0000.
G	RETENTION ABOVE GILBERT (V=690)	1794000.
H2	RETENTION BELOW GILBERT, RETENTION ABOVE (V=340)	884000.
K3	RETENTION AT PECOS W/RETENTION AT GILBERT (V=1120)	2926000.
	TOTAL	7017000.

Moore Business Forms, Inc.

MARICOPA COUNTY FLOOD CONTROL DISTRICT

COMBINATIONS OF PARTIAL SOLUTIONS TO GILA DRAIN PROBLEM

SOLUTION NUMBER 25	ITEM		COST
A0	NO CHANNEL THROUGH RESERVATION		0000.
C	CHANNEL ERYE TO PECOS (200 CFS)		543000.
D	CHANNEL WESTERN CANAL TO PECOS RD (Q=700)		870000.
E0	USE OF WESTERN CANAL FROM GILBERT		0000.
F	GILBERT CHANNEL AND TRAINING DIKES (Q 650)		680000.
H1	RETENTION BELOW GILBERT, NONE ABOVE (V=690)		1794000.
K3	RETENTION AT PECOS W/RETENTION AT GILBERT (V=1120)		2926000.
		TOTAL	6813000.

Moore Business Forms, Inc. f

MARICOPA COUNTY FLOOD CONTROL DISTRICT

COMBINATIONS OF PARTIAL SOLUTIONS TO GILA DRAIN PROBLEM

SUMMARY

SOLUTION	OPTIONS	COST
12	A1 C D E1 F	4898000.
23	A0 D E1 F I K6	5031000.
1	A2 D E0 F H1 I	5336000.
6	A1 D E1 F I	5473000.
2	A2 D E0 G H2 I	5540000.
3	A2 D E0 F H1 I J2	5726000.
7	A1 C D E0 F H1	5740000.
4	A2 D E0 G H2 I J2	5930000.
8	A1 C D E0 G H2	5944000.
9	A1 C D E0 F H1 J2	6130000.
20	A0 D E0 F H1 I J2 K6	6263000.
16	A0 D E0 F H1 I K5	6265000.
10	A1 C D E0 G H2 J2	6334000.
21	A0 D E0 G H2 I J2 K6	6467000.
17	A0 D E0 G H2 I K5	6469000.
5	A2 D E1 F I J1	6678000.
13	A0 C D E0 F H1 J2 K4	6811000.
25	A0 C D E0 F H1 K3	6813000.
14	A0 C D E0 G H2 J2 K4	7015000.
24	A0 C D E0 G H2 K3	7017000.
11	A1 C D E1 F J1	7082000.
22	A0 D E1 F I J1 K6	7215000.
18	A0 D E1 F I K2	7226000.
15	A0 C D E1 F J1 K4	7763000.
19	A0 C D E1 F K1	7775000.

Moore Business Forms, Inc.

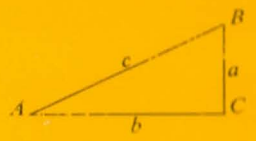
GILA DRAIN PROJECT

MISCELLANEOUS WORKSHEETS AND FIELD NOTES

ECONOMY FIELD BOOK

No. 8152-05

FORMULAE FOR SOLVING RIGHT TRIANGLES



$$\text{Sin } A = \frac{a}{c} = \text{Cos } B \qquad \text{Cot } A = \frac{b}{a} = \text{Tan } B$$

$$\text{Cos } A = \frac{b}{c} = \text{Sin } B \qquad \text{Sec } A = \frac{c}{b} = \text{Cosec } B$$

$$\text{Tan } A = \frac{a}{b} = \text{Cot } B \qquad \text{Cosec } A = \frac{c}{a} = \text{Sec } B$$

Given	Required	Solution
A, c	B, a, b	$B = 90° - A, a = C \sin A, b = C \cos A.$
A, b	B, a, c	$B = 90° - A, a = b \tan A, c = \frac{b}{\cos A}.$
A, a	B, b, c	$B = 90° - A, b = a \cot A, c = \frac{a}{\sin A}.$
a, c	A, B, b	$\sin A = \frac{a}{c}, \cos B = \frac{a}{c}, b = \sqrt{(c+a)(c-a)}$
a, b	A, B, c	$\tan A = \frac{a}{b}, \cot B = \frac{a}{b}, c = \sqrt{a^2 + b^2}$

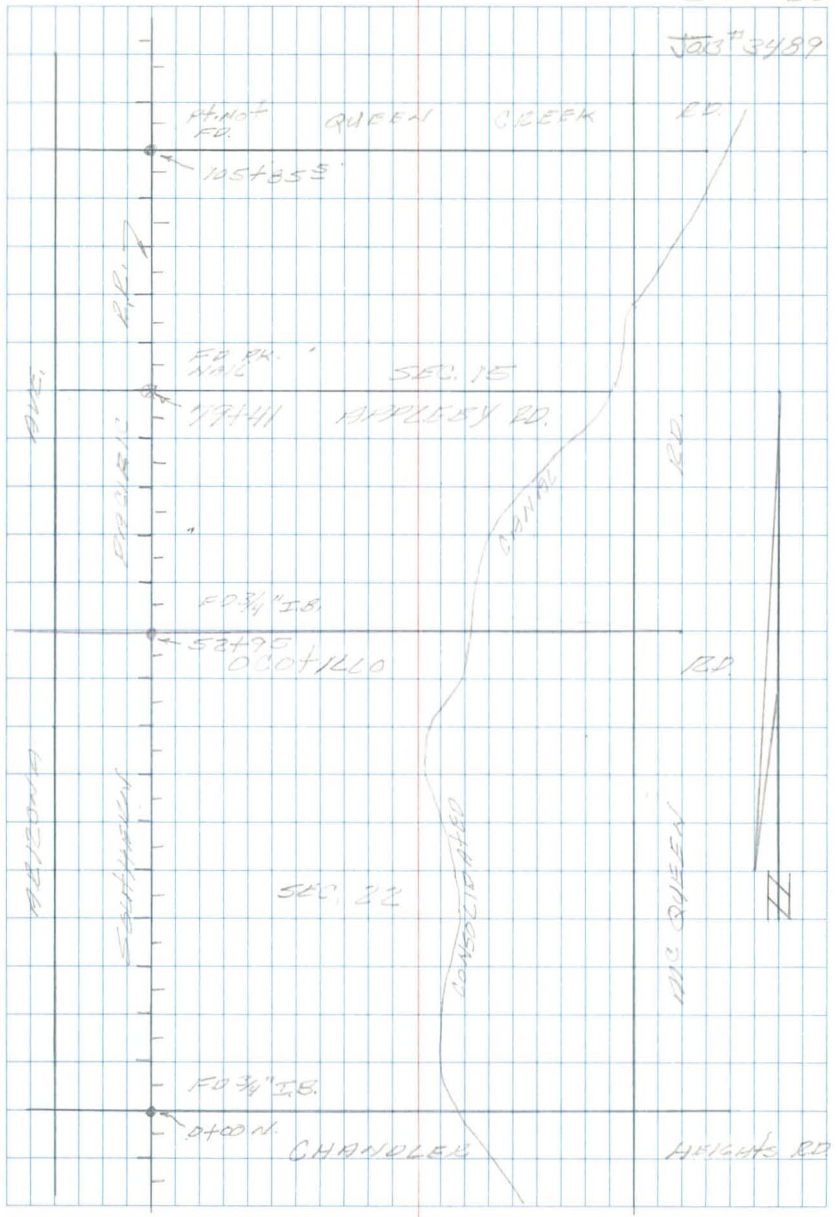
FORMULAE FOR SOLVING OBLIQUE TRIANGLES

Given	Required	Solution
A, a, b	B, c	$\sin B = \frac{b \sin A}{a}, c = \frac{a \sin C}{\sin A}$
A, B, a	b	$b = \frac{a \sin B}{\sin A}$
a, b, C	A, c	$A + B = 180° - C, C = \frac{a \sin C}{\sin A}$
a, b, c	Area	side $\frac{a+b+c}{2}$, area $= \sqrt{s(s-a)(s-b)(s-c)}$
A, b, c	Area	area $= \frac{bc \sin A}{2}$
A, B, C, a	Area	area $= \frac{a^2 \sin B \sin C}{2 \sin A}$

Printed in England

TOPO
SURVEY
OF
PT. SEC. 15 & 22
T 2 S. - R 5 E.

JOB # 3497
11-10-92
C. ASHMORE
P. HARMON
D. SLUTES


JOB # 3459
HINOT FD.
QUEEN CREEK RD.
105+85.5'
FD PK. NAIL
SEC. 15
179+11
HARLEY RD.
FD 3/4" I.B.
52+75
0.30+11.0
SEC. 22
FD 3/4" I.B.
0+00 N.
CHANDLER
HEIGHTS RD
MT. QUEEN

Location Job 3489

on

PIPE LINE

OF

BRIDGES - CULVERTS &

ROAD'S CROSSING R.R.

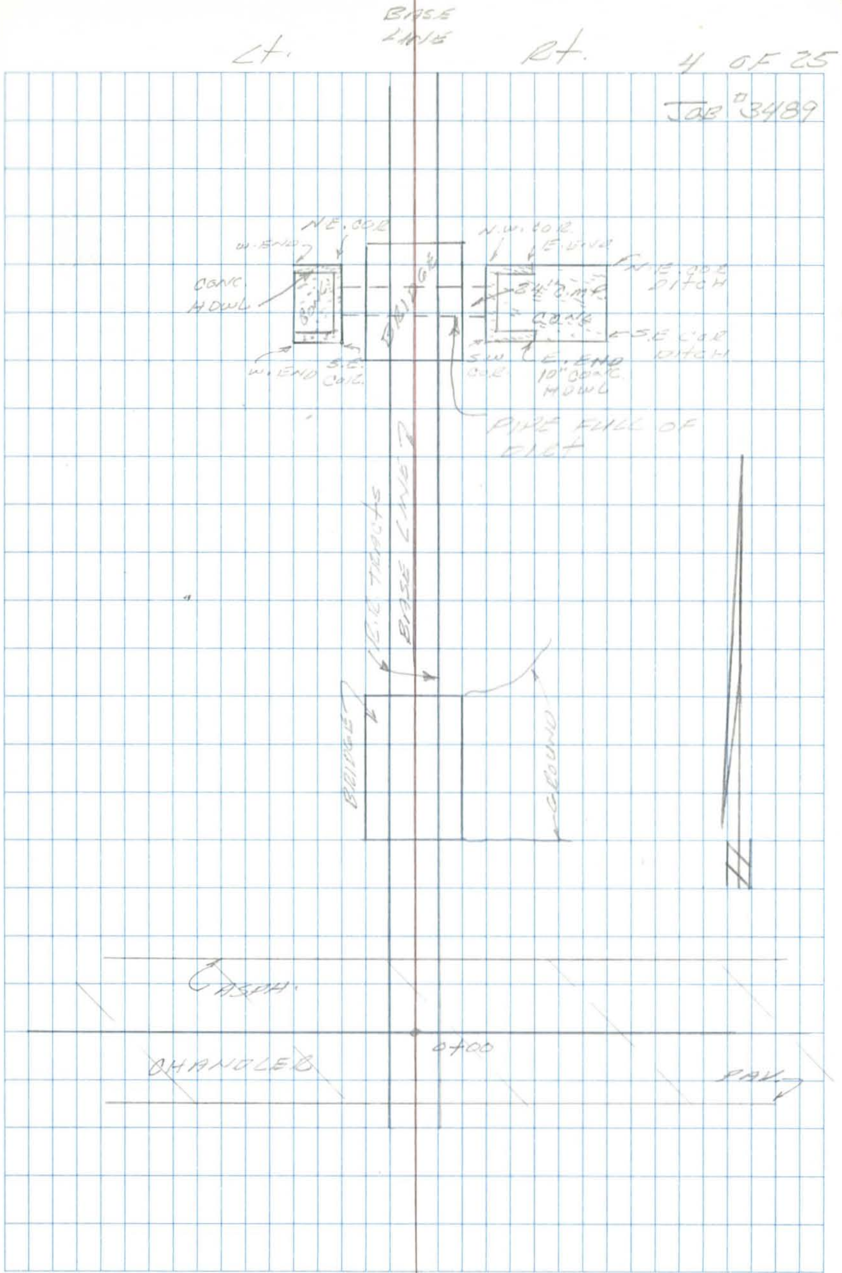
BASE LINE = ℄ R.R. TRACK

STOW = " " " " ℄

CHANDLESS HEIGHTS CO.

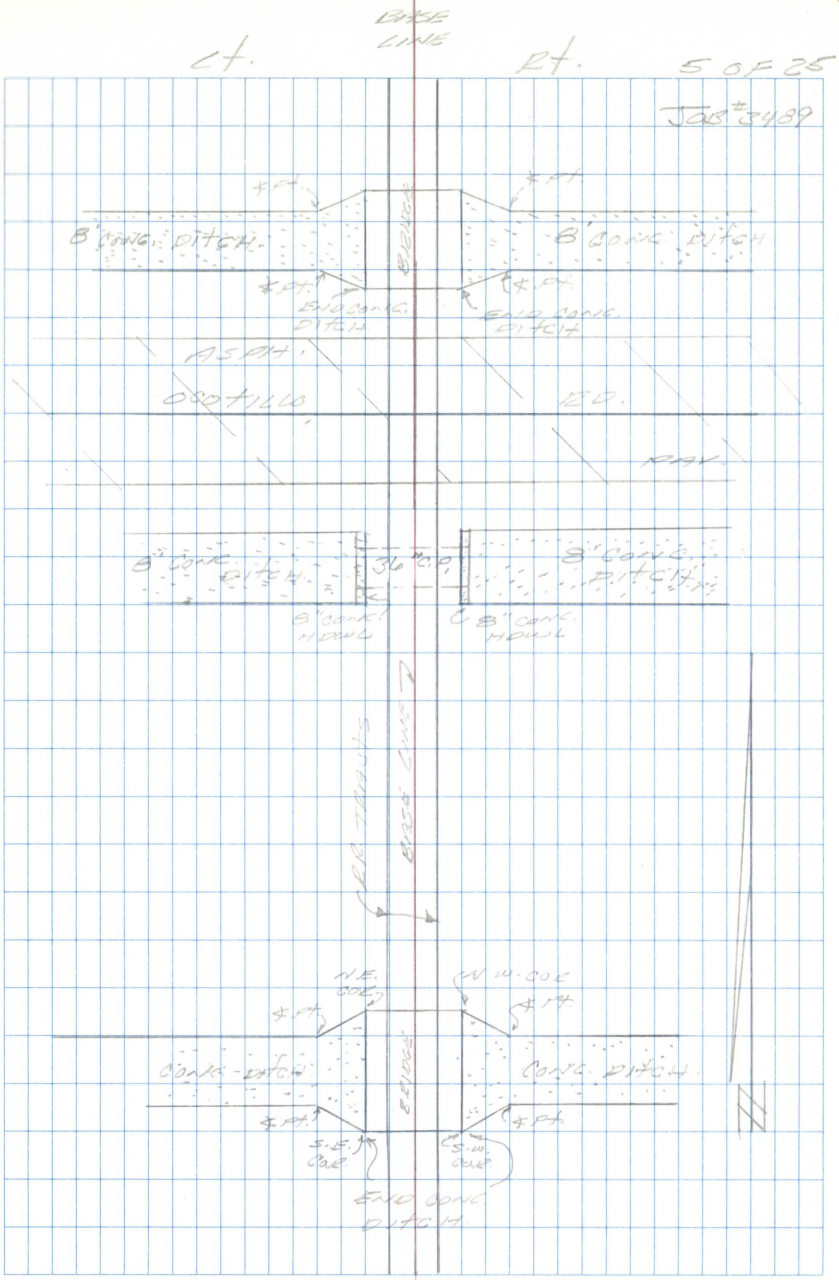
JOB # 3489

STA.	LT.	RT.	
14+02	8'	8'	N. EDGE RR TIE BRIDGE
13+99		24'	N.E. COR. CONC. DITCH
		14'	E. END CONC. HDWL
13+99		9'	N.W. COR. 10" CONC. HDWL
	14'		W. END CONC. HDWL
13+99	9'		N.E. COR. 10" CONC. HDWL
13+94		24'	S.E. COR. CONC. DITCH.
		14'	E. END CONC. HDWL
13+94		9'	S.W. COR. 10" CONC. HDWL
	14'		W. END CONC. HDWL
13+94	9'		S.E. COR. 10" CONC. HDWL
13+91	8'	8'	S. EDGE RR TIE BRIDGE
0+59	8'	8'	N. EDGE RR TIE BRIDGE
0+28	8'	8'	S. EDGE RR TIE BRIDGE
0+11		0	N. EDGE ASPH. PAV.
0+00		0	℄ CHANDLER HEIG. RD.
-0+09		0	S. EDGE ASPH. PAV.



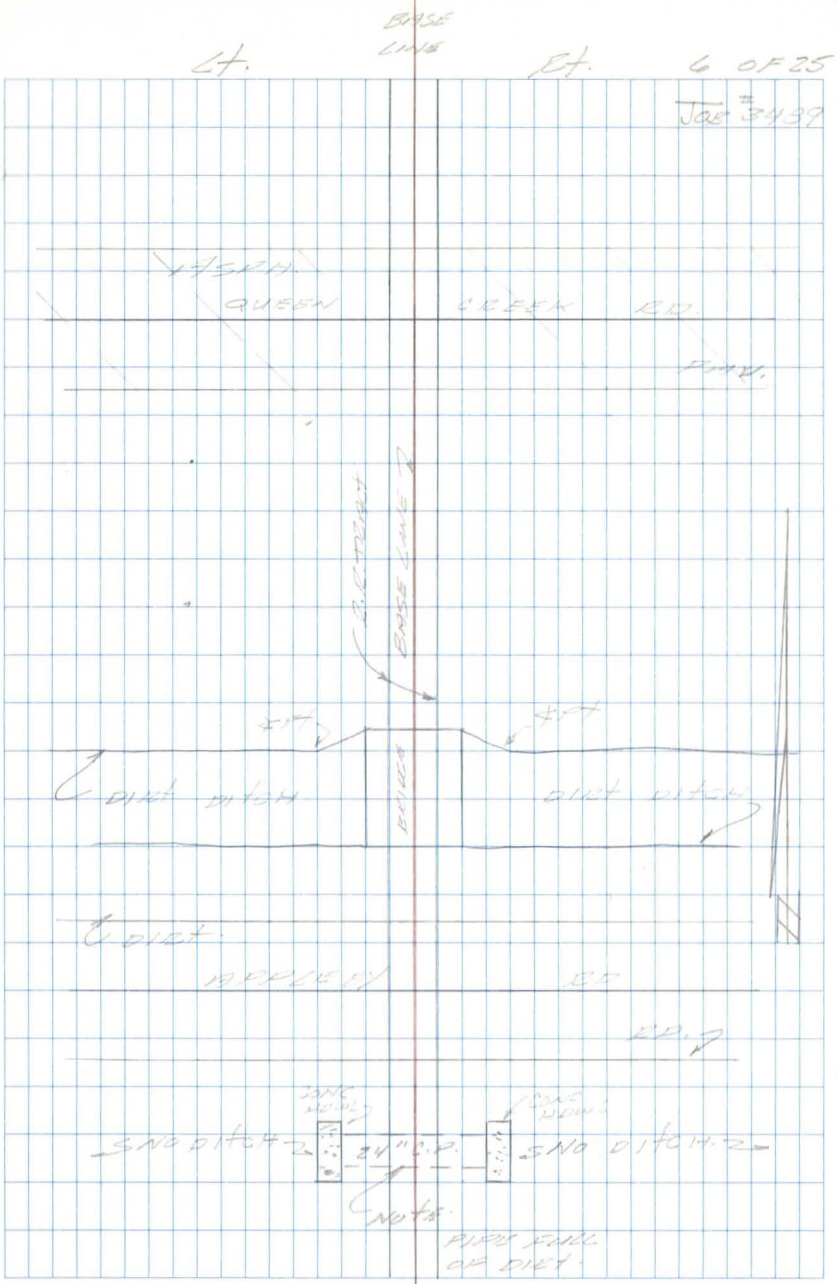
Job # 3489

Sta.	Lt.	Rt.	
53+28	8'	8'	N EDGE R.E TIE EDGES
53+28	8'	8'	N EDGE & END CONC. DITCH.
53+27	13'	13'	℄ Pt. N. EDGE CONC. DITCH
53+19	13'	13'	℄ Pt. - S. EDGE CONC. DITCH
53+15	8'	8'	S EDGE & END CONC. DITCH
53+18	8'	8'	S EDGE S.E TIE EDGES
53+09.5		0	N EDGE ASPH. PAV.
52+95		0	℄ CONTROL ED.
52+85.5		0	S. EDGE ASPH. PAV.
52+77	11'		CONC. DITCH TO WEST N.E. COR. 8" CONC. HOWL & N EDGE
52+77		11'	CONC. DITCH TO EAST. N.W. COR. 8" CONC. HOWL & N EDGE
52+69	11'		CONC. DITCH TO WEST S.E. COR. 8" CONC. HOWL & S. EDGE
52+69		11'	CONC. DITCH TO EAST. S.W. COR. 8" CONC. HOWL & S. EDGE
26+35	8'	8'	N. EDGE R. E TIE EDGES
26+35		8'	N. W. COR. CONC. DITCH
26+35	8'		N. E. COR. CONC. DITCH
26+14	13'	13'	℄ Pt. N. SIDE CONC. DITCH
26+38	13'	13'	℄ Pt. S. SIDE CONC. DITCH
26+27	8'		S. E. COR. CONC. DITCH
26+27		8'	S. W. COR. CONC. DITCH
26+27	8'	8'	S. EDGE R. E TIE EDGES



Job # 3439

Sta.	Lt.	Rt.	
105+99.5		0	N. EDGE ASPH. PVMT
105+95.5		0	2' RIGHT JOINT CO
105+75.5		0	S. EDGE ASPH. PVMT
99+71	3'	3'	N. EDGE DIST DIT. H. N. EDGE CENTER LINE
99+69	15'	15'	DITCH 5.5' W. * PT. - N. EDGE OF PVMT DIST
99+61	9'	9'	S. EDGE OF PVMT DIST 3.5' W. S. EDGE CENTER LINE DIST
99+48		0	N. EDGE DIST COR.
99+41		0	2' RIGHT OF BC
99+32		0	S. EDGE DIST COR.
99+16.5	12'		N.E. COR. 15' CONC. HDWL
99+16.5		12'	N.W. COR. 15' CONC. HDWL
99+11.5	12'		S.E. COR. 15' CONC. HDWL
99+11.5		12'	S.W. COR. 15' CONC. HDWL



JOB # 2457

BM

ACCOUNT

BM = ASSUMED ELEV. 1220.00

ON TOP OF 5.2' CHANNEL HEADWALL

@ N 12.12. TRACKS

Sta.	BS	HI.	FS.	Elev.
Bm #1				1230.00
	2.86	1232.86		
Bm #2			2.86	1230.00
	3.60	1233.60		
TBm #1			2.20	1231.40
Bm #3			1.80	1231.80
	1.81	1233.61		
TBm #2			1.23	1232.38
Bm #4			0.95	1232.66
	1.91	1234.57		

1230.00
+ 2.86
1232.86
- 2.86
1230.00
+ 3.60
1233.60
- 2.20
1231.40
+ 1.81
1233.21
- 1.80
1231.41
+ 1.91
1233.32
- 0.95
1232.37

Bm #1 = Top Inc. Sta. 0+00

Job #3489

Bm #2 = Top of East Bnk @ Sta. 10+00

TBm #1 = Top East Bnk Sta. 14+00

Bm #3 = Top East Bnk Sta. 20+00

TBm #2 = Top East Bnk Sta. 26+00

Bm #4 = Top East Bnk Sta. 30+00

JOB # 3489

STA.	B.S.	H.I.	F.S.	ELEV.
		1224.37		
BM #5			0.83	1223.54
	2.57	1226.11		
BM #6			0.83	1225.28
	4.61	1229.89		
TBM #3			4.26	1225.63
BM #7			4.71	1225.18
	4.17	1229.35		
BM #8			4.77	1224.58
	4.15	1228.73		
TP.			4.46	1224.27
	4.34	1228.61		

24.37
−0.83
23.54
+2.57
26.11
−0.83
25.28
+4.61
[illegible]
28.61

BM #5 = TOP EAST RAIL STA. 40+00

BM #6 = TOP EAST RAIL STA. 50+00

TBM #3 = ON 24" I.B. ℄ OCOTILLO RD.

BM #7 = TOP EAST RAIL STA. 60+00

BM #8 = TOP EAST RAIL STA. 70+00

TP = TOP EAST RAIL STA 75+00±

JOB #3489

Sta.	BS.	H.I.	FS.	Elev.
		1238.61		
BM #9			4.28	1234.33
	4.23	1238.56		
TP.			4.44	1234.12
	4.36	1238.48		
BM #10			4.53	1233.95
	4.16	1238.11		
TP			4.44	1233.67
	4.13	1237.80		
BM #11			4.61	1233.19
	4.16	1237.35		
BM #12			4.61	1232.74

BM #9 = Top East End Sta. 80+00

TP. Top East End Sta 54+00±

BM #10 = Top East End Sta 20+00

TP = Top East End Sta. 96+00±

BM #11 = Top East End Sta 100+00

BM #12 = On Rail @ Queen Creek Rd. & C.L. Track. Sta. 1054855'

Job 3497

Sta.	BS.	HI.	FS.	ELEV.	
	RETURN	CIRCUIT			
BM #12				1232.71	
	4.54	1237.25			
TP			4.52	1232.73	33.77
	5.11	1237.84			+4.54
					29.35
					-4.50
					24.85
TP			4.66	1233.18	+5.11
	5.04	1233.22			29.96
					-4.66
					25.30
					+5.04
TP			4.67	1233.55	28.22
	4.97	1238.52			-4.67
					33.56
					+4.97
					28.59
					-4.73
TP			4.73	1233.79	23.86
	4.83	1238.62			+4.83
					28.69
					-4.92
					23.77
					+5.01
TP			4.83	1233.80	28.78
	5.01	1238.81			-4.83
					33.97
					+5.01
					28.98
					-4.99
TP			4.60	1234.21	23.99
	5.01	1239.22			+5.08
					28.81
TP			4.49	1234.73	
	5.08	1239.81			

BM #12 = ELEV 1232.71

TP = ON U.C. ELEV

STA	BS	HI.	FS	ELEV.
		1229.81		
TP.			4.80	1225.01
	0.95	1225.96		
TP.			1.96	1224.00
	1.33	1225.33		
TP			2.63	1222.70
	1.45	1224.15		
TP.			2.15	1222.00
	1.35	1223.35		
TP.			1.80	1221.45
	1.96	1223.41		
TP.			2.61	1220.80
	2.25	1223.05		
TP.			2.83	1220.22
	2.53	1222.75		
BM #1			2.84	1219.91
			CHK.	- 0.09
	101.22		101.21	- 0.09

37.41
- 4.80
32.61
+ 0.95
33.56
- 1.96
31.60
+ 1.33
32.93
- 2.63
30.30
+ 1.45
31.75
- 2.15
29.60
+ 1.35
30.95
- 1.80
29.15
+ 1.96
31.11
- 2.61
28.50
+ 2.25
30.75
- 2.83
27.92
+ 2.53
30.45
- 2.54
1991

TP: ON E.B. SPIKE

" " "

" " "

" " "

" " "

" " "

" " "

" " "

BM #1 = ELEV. 1220.00

Job # 3469

CROSS SECTION

0400 N = 2 GUNNITE HOLES ED & 2 E.B. TESTS

ALL OTH'S FLEX. CH. & CT. FROM BASE LINE (2 CC + COATS)

STA.	BS.	HI.	FS.	ELEV.
BM #1				1220.00
	0.63	1220.63		
0+00 DIST. & ELEV. ℄ CHANDLER HEIGHTS RD.				
SIGHT NORTH & Rt. 89°28'00"				
0+25				
BM #1			0.63	1220.00
	6.97	1226.97		
0+00				
0+43				
BM #1			6.97	1220.00

JOB # 3489

WEST Lt.		BASE LINE		EAST Rt.

HI: 1220.63

1215.17 5.46 855' ℄ PAV.	1218.43 2.20 100' ℄ PAV.	1220.00 0.63 0' ℄ PAV.
1214.42 6.21 1320' ARIZ. AVE. E. EDGE PAV.		
1214.11 6.52 1350' PAV.	1214.33 6.30 855' GROUND	1215.63 5.00 100' GROUND

HI: 1226.97

1220.00 6.97 0 ℄ PAV.	1225.75 1.22 1208' ℄ PAV.	1224.67 2.30 2014' ℄ PAV. CHANNEL BK.
1220.17 6.80 0' E.E. BEG.	1215.47 11.50 8' GROUND	1220.77 6.20 1208' GROUND

STA.	B.S.	H.I.	F.S.	ELEV.
BM #2				1220.80
	6.37	1227.17		
10+00	℄ 90° FROM BASE LINE			
13+96.5	C.P. UNDER E.C.			
BM #2			6.37	1222.33

Job # 3489

WEST Lt. | BASE LINE | EAST Rt.

H.I. = 1227.17

1221.47	1215.67	1215.37
5.70	11.50	11.80
0'	35'	43'
E.E. BED	TOE FILL	TOE

1221.07	1217.37	1217.87
6.10	9.80	9.30
1210'	68'	53'
EDGE FIELD	W. EDGE FIELD	TOP EDGE RD.

1221.57	1222.37	1224.57
5.60	4.80	2.60
1245'	1700'	1730'
EDGE FIELD	EDGE FIELD	CANAL BANK

1215.67	1220.40	1215.57
11.50	6.77	11.60
95'	0'	95'
F.C. C.P.	E.C. [illegible]	F.C. C.P.

STA.	BS.	HI.	FS.	ELEV.
BM #3				1221.60
	5.96	1227.56		
30+00				
26+31	BRIDGE & [illegible] [illegible]			
BM #3			5.96	1221.60
BM #4				1222.46
	5.64	1228.10		
30+00				
BM #4			5.64	1222.46

1221.60
+5.96
1227.56

1222.46
+5.64
1228.10

WEST Lt — BASE LINE — EAST Rt

JOB #3489

HI = 1227.56

1220.96 6.60 0' E.E. BED	1217.56 10.00 20' TOE FILL	1217.06 10.50 40' TOE
1221.56 6.00 1210' EDGE FIELD	1218.26 9.30 20' EDGE FIELD	1218.46 9.10 52' EDGE RD
1221.66 5.90 1250' EDGE FIELD	1223.06 4.50 1795' EDGE FIELD	1224.86 2.70 1815' CANAL BANK

1216.66 10.90 13' F.L. DITCH	1221.36 6.20 0' E.E. BED	1216.66 10.90 13' F.L. DITCH

HI = 1228.10

1221.75 6.35 0' E.E. BED	1216.40 11.70 20' TOE FILL	1216.30 11.80 30' TOE	1218.70 9.40 40' EDGE RD.
1222.40 5.70 1485' EDGE FIELD	1222.60 5.50 1245' EDGE FIELD	1221.70 6.40 1210' EDGE FIELD	1218.70 9.40 60' EDGE FIELD
1225.50 2.60 1500' CANAL BANK			

STA.	BS.	HI.	FS.	ELEV.
BM #5				1223.54
	5.74	1229.28		
40+00				
BM #5			5.74	1223.54
TBM #3				1225.63
	4.22	1229.85		
52+45	50' SOUTH ℄ OCOTILLO			
52+73	℄ CONC. IRR. DITCH			

1223.54
+5.74
1229.28

1225.63
+4.22
1229.85

WEST Lt. — BASE LINE — EAST Rt.

HI = 1229.28 JOB #3189

1224.28 / 5.00 / 0 / ℄ RD.
1217.58 / 11.70 / 25' / TOE FILL
1217.88 / 11.40 / 38' / TOE

1223.38 / 5.90 / 1210' / EDGE FIELD
1220.08 / 9.20 / 70' / EDGE FIELD
1219.88 / 9.40 / 55' / EDGE RD.

1223.98 / 5.30 / 1245' / EDGE FIELD
1223.88 / 5.40 / 1360' / EDGE FIELD
1226.98 / 2.30 / 1375' / CANAL BANK

HI = 1229.85

DIST. & ELEV. ℄ OCOTILLO RD. & 50' SOUTH & 50' NORTH

SIGHT NORTH & Rt. 89°18'00"

1220.45 / 9.40 / 25' / TOE FILL
1220.35 / 9.50 / 40' / TOE
1221.95 / 7.90 / 60' / EDGE RD.

1224.05 / 5.80 / 1250' / EDGE FIELD
1224.45 / 5.40 / 1305' / EDGE FIELD
1222.15 / 7.70 / 85' / EDGE FIELD

1224.45 / 5.40 / 2050' / EDGE FIELD
1228.75 / 1.10 / 2100' / CANAL BANK

1219.55 / 10.30 / 11' / F.L. C.P.
1219.55 / 10.30 / 11' / F.L. C.P.
1223.30 / 6.55 / 1215' / F.L. DITCH W. & S.

Sta.	BS.	HI.	FS.	ELEV.
		1229.85		
52+95	℄ OCOTILLO RD.			
53+23	2' IRR. DITCH			
53+45	50' NORTH OF ℄ OCOTILLO RD			
TBM#3			4.22	1225.63

HI = 1229.85 JOB # 3489

	1225.63 4.22 0 PAV. ℄ R.R.		1224.10 5.75 130' PAV.	1224.93 4.93 1205 PAV.
			1229.65 0.20 2130' CANAL BANK	1225.85 4.00 1765' PAV.
1218.35 11.50 13' F.C.		1218.25 11.60 13' F.C.	1221.67 8.18 1205' F.C.	1222.70 7.15 2110 F.C.
		1219.85 10.00 25' TOE FILL	1219.65 10.20 36' TOE	1222.65 7.20 56' EDGE RD.
		1224.45 5.40 2130' EDGE FIELD	1223.95 5.90 1205' FIELD	1221.85 8.00 70' EDGE FIELD
		1228.05 1.80 2180' CANAL BANK		

STA.	BS.	HI.	FS.	ELEV.
Bm #7				1225.18
	3.37	1228.55		
60+00		@ 90° FROM BASE LINE		
Bm #7			3.37	1225.18
70+00				
Bm #8				1224.58
	5.80	1230.38		
Bm #8			5.80	1224.58

35.18
+3.37
38.55

31.58
+ 2.80
30.38

WEST Lt.	BASE LINE	EAST Rt.

HI = 1228.55 JOB #3499

1224.45	1218.45	1218.45
4.10	10.10	10.10
0	25'	44'
EOR	TOE	TOE
BED	FILL	

1223.55	1221.55	1221.95
5.00	7.00	6.60
16.80'	70'	52'
FIELD	EDGE	EDGE
	FIELD	RD.

3.30	1.50
24.50'	24.80'
EDGE	CANAL
FIELD	BANK

HI = 1230.38

1223.88	1218.08	1217.78
6.50	12.30	12.60'
0	25'	43'
EOR	TOE	TOE
BED	FILL	

1223.38	1219.88	1220.68
7.10	10.50	9.70
16.60'	45'	52'
FIELD	EDGE	EDGE
	FIELD	RD.

1225.33	1227.98
5.05	2.40
27.80'	28.10
EDGE	CANAL
FIELD	BANK

2.80
+ 2.80
5.60

14.0

STA.	BS.	HI.	FS.	ELEV.
BM #9				1224.33
	1.40	1225.73		
79+00	DIST. & ELEV. FROM STA. 79+00 TO STA. 80+00 - SIGHT NORTH & RT. 89° 20'00"			
79+14	C.P. UNDER R.R.			
79+41	℄ APPLEBY RD.			
79+66	℄ CONC. IRR. DITCH			
80+00				
TP.			3.46	1222.27
	5.06	1227.33		

24.33
+1.40
25.73
−3.46
22.27
+5.06
27.33
−2.37
24.96
+6.06
31.0?

WEST Lt. | BASE LINE | EAST Rt.

HI = 1225.73 JOB #3489

1218.53 / 7.20 / 25' / TOE FILL — 1217.88 / 7.85 / 52' / TOE — 1220.13 / 5.60 / 60' / EDGE RR.

1221.83 / 3.90 / 1100' / FIELD — 1219.63 / 6.10 / 80' / EDGE FIELD

1218.83 / 6.90 / 13.5' / F.L. C.P.

1224.38 / 1.35 / 0 / ℄ EDGE R.R. TRACT — 1220.43 / 5.30 / 120' / ℄ ROAD — 1222.27 / 3.46 / 1100' / ℄ ROAD

1218.53 / 7.20 / 8' / FL. DITCH — 1219.33 / 6.40 / 1100' / FL. DITCH

1219.93 / 5.80 / 20' / TOE FILL — 1219.93 / 5.80 / 60' / EDGE FIELD — 1222.03 / 3.70 / 1100' / FIELD

STA.	BS.	HI.	FS	ELEV.
		1227.33		
79+00				
79+41		℄ ROAD		
79+66		DITCH		
84+00				
TP.			3.37	1224.96
	6.06	1231.02		

WEST ℄ BASE LINE EAST ℄

HI = 1227.33 JOB #3499

12.25.63
2.30
2000'
FIELD

1224.96
2.37
2000'
℄
ROAD

1223.08
4.25
2000'
℄
DITCH

1224.63
2.70
3000'
FIELD

Sta.	BS.	HI.	FS.	ELEV
		1231.02		
79+00				
79+41		℄ ROAD		
79+66		SWC. DITCH		
80+00				
		EXISTING GROUND		
TP.			6.20	1224.83
	2.50	1227.32		
TP.			5.33	1221.99
	3.38	1225.37		
BM #9			1.02	1224.35
			CHECK	+0.02

WEST CT. BASE LINE EAST BT.

HI = 1231.02 JOB #3489

1226.32
4.70
2900'
EDGE
FIELD

1226.12
4.90
2900'
℄
ROAD.

1228.77
2.25
2980'
CENTER
BANK

1224.12
6.90
2920'
FL
DITCH

1225.52
5.50
2970'
EDGE
FIELD

BM #9 = EL. 1224.33

Sta.	BS.	HI.	FS.	ELEV.
BM #10				1223.85
	5.32	1229.17		
90+00				
			4.25	1224.83
	6.06	1230.88		
	RETURN	CIRCUIT		
TP			5.70	1224.98
	4.00	1226.98		
BM #10			5.13	1223.85

WEST Lt. | BASE LINE | EAST Bt.

23 OF 35

Job # 3489

HI = 1229.17

1223.07	1217.57	1217.87
6.10	11.60	11.30
0'	32'	50'
EC	TOE	TOE
BED	FILL	

1221.37	1218.37	1219.27
7.80	10.80	9.90
1240'	77'	54'
EDGE	EDGE	EDGE
PAVD	FILL	SD.

1223.17	1223.87
6.00	5.30
1230'	2470'
EDGE	FILL
FILL	

HI = 1230.98

1229.08	1225.93
1.90	505
3790'	3750'
CENTER	EDGE
BANK	FILL

BM #10 = ELEV. 1223.85

Sta.	BS.	HI.	FS.	ELEV.
BM #12				1222.71
	4.16	1226.87		
105+35				
105+85				
TP.			4.47	1222.40
	7.02	1231.42		

@ QUEEN CREEK RD.

WEST Lt | BASE LINE | EAST Lt

HI = 1226.87 Job #8489

1216.27	1216.27	1218.67
10.60	10.60	9.20
20'	40'	50'
TOE	TOE	EDGE
FILL		RD.
1222.27	1219.57	1217.77
4.60	7.30	9.10
1225'	1225'	70'
EDGE	EDGE	EDGE
FIELD	FIELD	FIELD
1223.27		
3.60		
2440'		
FIELD		
1222.71	1220.03	1221.67
4.16	6.84	5.20
0'	320'	1225
R.R. TRK	@	@
@ ℄	RD.	RD
		1222.90
		3.97
		2440'
		@
		RD

Sta.	BS.	HI.	FS.	ELEV.
		1231.42		
10+35				
10+85	2	QUEEN CREEK RD.		
		BENCH MARK		
TP.			9.21	1222.21
	4.93	1227.14		
BM #12			4.53	1222.61
			+0.10	

WEST LT. | BASE LINE | EAST LT.

HI = 1231.42

1225.02
4.40
3825
EDGE FIELD.

1231.42
0.10
4.90
CANAL BANK

1226.52
5.00
3900
GROUND

1227.52
3.90
4370
GROUND

1226.71
4.71
3875
2 RD.
2 EMT.

1228.87
2.55
4300
2 RD.

1231.42
0.00
4400
CANAL BANK

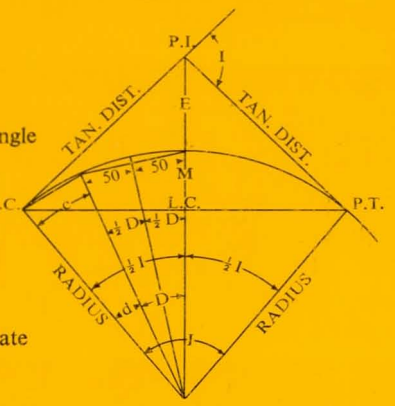
BM #12 = ELEV. 1222.71

JOB #3489

25 OF 25

CURVE FORMULAE

D = Degree of Curve
1° = 1-Degree of Curve
2° = 2-Degree of Curve
P.C. = Point of Curve
P.T. = Point of Tangent
P.I. = Point of Intersection
I = Intersection of Angle, Angle between Two Tangents
L = Length of Curve, from P.C. to P.T.
T = Tangent Distance
E = External Distance
R = Radius
L.C. = Length of Chord
M = Length of Middle Ordinate
c = Length of Sub-Chord
d = Angle of Sub-Chord



$$R = \frac{L.C.}{2 \sin \frac{1}{2} I} \quad T = R \tan \tfrac{1}{2} I = \frac{L.C.}{2 \cos \frac{1}{2} I}$$

$$\frac{L.C.}{2} = R \sin \frac{I}{2}, \; D\,1° = R = 5730, \; D\,2° = \frac{5730}{2}, \; D = \frac{5730}{R}$$

$$M = R\,(1 - \cos \tfrac{1}{2} I), \; = R - R \cos \frac{I}{2}$$

$$\frac{E + R}{R} = \sec \frac{I}{2}, \; \frac{R - M}{R} = \cos \frac{I}{2}$$

$$c = 2\,R \sin \tfrac{1}{2} d, \; d = \frac{c}{2\,R}$$

$$L.C. = 2\,R \sin \tfrac{1}{2} I, \; E = R\,(\sec \tfrac{1}{2} I - 1), \; = R \sec \frac{I}{2} - R$$

Minutes in Decimals of a Degree

1′	·0167	11′	·1833	21′	·3500	31′	·5167	41′	·6833	51′	·8500
2	·0333	12	·2000	22	·3667	32	·5333	42	·7000	52	·8667
3	·0500	13	·2167	23	·3833	33	·5500	43	·7167	53	·8833
4	·0667	14	·2333	24	·4000	34	·5667	44	·7333	54	·9000
5	·0833	15	·2500	25	·4167	35	·5833	45	·7500	55	·9167
6	·1000	16	·2667	26	·4333	36	·6000	46	·7667	56	·9333
7	·1167	17	·2833	27	·4500	37	·6167	47	·7833	57	·9500
8	·1333	18	·3000	28	·4667	38	·6333	48	·8000	58	·9667
9	·1500	19	·3167	29	·4833	39	·6500	49	·8167	59	·9833
10	·1667	20	·3333	30	·5000	40	·6667	50	·8333	60	1·0000

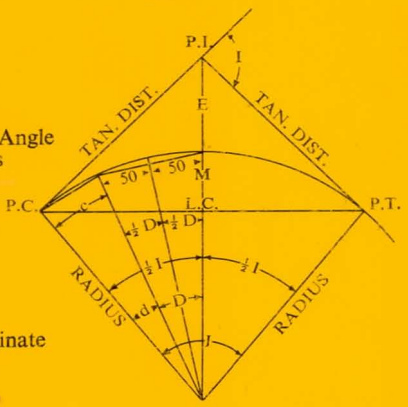
Inches in Decimals of a Foot

1/16	3/32	1/8	5/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16
·0052	·0078	·0104	·0156	·0208	·0260	·0313	·0417	·0521	·0625	·0729	

1	2	3	4	5	6	7	8	9	10	11
·0833	·1667	·2500	·3333	·4167	·5000	·5833	·6667	·7500	·8333	·9167

CURVE FORMULAE

D = Degree of Curve
1° = 1-Degree of Curve
2° = 2-Degree of Curve
P.C. = Point of Curve
P.T. = Point of Tangent
P.I. = Point of Intersection
I = Intersection of Angle, Angle between Two Tangents
L = Length of Curve, from P.C. to P.T.
T = Tangent Distance
E = External Distance
R = Radius
L.C. = Length of Chord
M = Length of Middle Ordinate
c = Length of Sub-Chord
d = Angle of Sub-Chord



$$R = \frac{L.C.}{2 \sin \frac{1}{2} I} \quad T = R \tan \tfrac{1}{2} I = \frac{L.C.}{2 \cos \frac{1}{2} I}$$

$$\frac{L.C.}{2} = R \sin \frac{I}{2}, \; D\,1° = R = 5730, \; D\,2° = \frac{5730}{2}, \; D = \frac{5730}{R}$$

$$M = R (1 - \cos \tfrac{1}{2} I), = R - R \cos \frac{I}{2}$$

$$\frac{E + R}{R} = \sec \frac{I}{2}, \; \frac{R - M}{R} = \cos \frac{I}{2}$$

$$c = 2 R \sin \tfrac{1}{2} d, \; d = \frac{c}{2 R}$$

$$L.C. = 2 R \sin \tfrac{1}{2} I, \; E = R (\sec \tfrac{1}{2} I - 1), = R \sec \frac{I}{2} - R$$

Minutes in Decimals of a Degree

1′	·0167	11′	·1833	21′	·3500	31′	·5167	41′	·6833	51′	·8500
2	·0333	12	·2000	22	·3667	32	·5333	42	·7000	52	·8667
3	·0500	13	·2167	23	·3833	33	·5500	43	·7167	53	·8833
4	·0667	14	·2333	24	·4000	34	·5667	44	·7333	54	·9000
5	·0833	15	·2500	25	·4167	35	·5833	45	·7500	55	·9167
6	·1000	16	·2667	26	·4333	36	·6000	46	·7667	56	·9333
7	·1167	17	·2833	27	·4500	37	·6167	47	·7833	57	·9500
8	·1333	18	·3000	28	·4667	38	·6333	48	·8000	58	·9667
9	·1500	19	·3167	29	·4833	39	·6500	49	·8167	59	·9833
10	·1667	20	·3333	30	·5000	40	·6667	50	·8333	60	1·0000

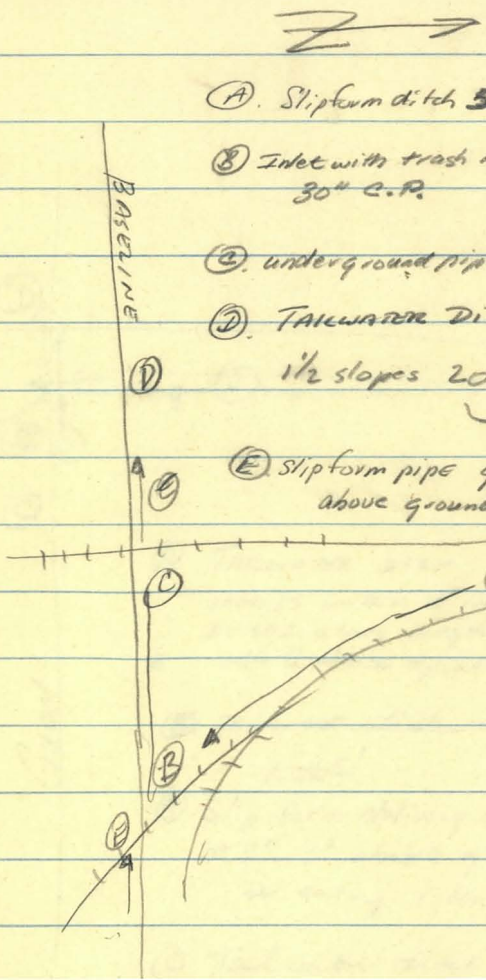
Inches in Decimals of a Foot

1/16	3/32	1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	7/8
·0052	·0078	·0104	·0156	·0208	·0260	·0313	·0417	·0521	·0625	·0729

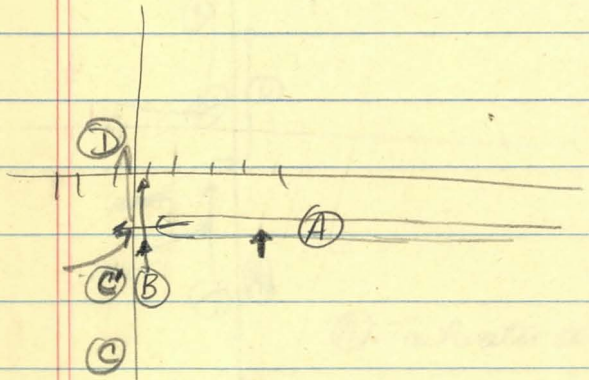
1	2	3	4	5	6	7	8	9	10	11
·0833	·1667	·2500	·3333	·4167	·5000	·5833	·6667	·7500	·8333	·9167

No. 9058 LEGAL PAD Gates

Baseline Rd



Guadalupe Rd



(A) TAILWATER DITCH FLOW S. CROSSES UNDER B IN ~~4'~~ BOX. Inlets along length but clogged @ ~~at~~ +1' above grade of field.

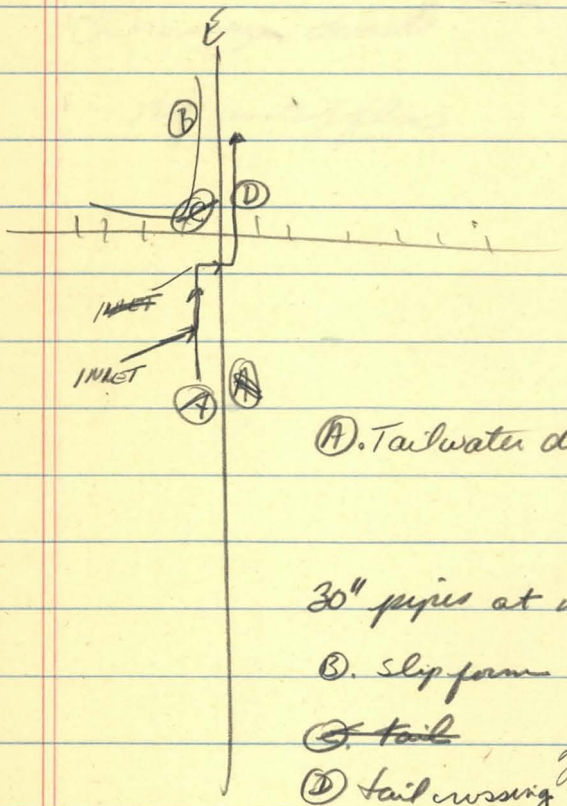
~~(B) TAILWATER ditch crossing, 7'x5'~~

(B) Slip form delivery chan @ 2'-3' above grade no entry likely

(C) Tail water ditch 7x5' inlet at (C')

(D) ditch ~~@~~ 15x7.

~~Ello~~ ELLIOT



Ⓐ. Tailwater ditch

30" pipes at inlets, turn

Ⓑ. slip form

~~Ⓒ. tail~~

Ⓓ tail crossing gated 10×6 gunite

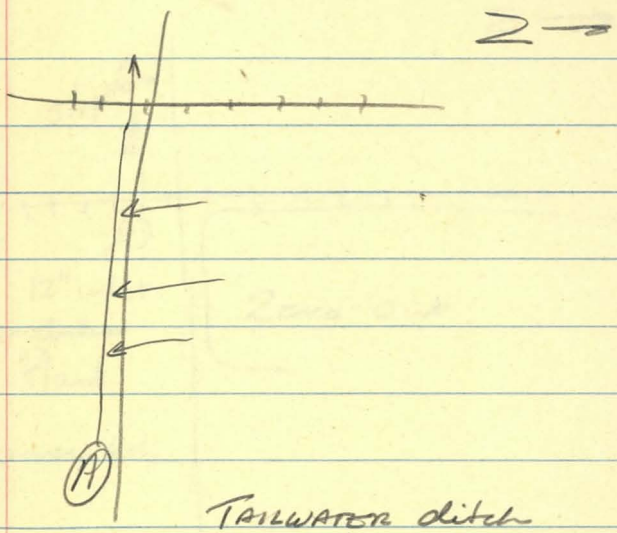
Comment. inlet is about 1.5 feet higher than RR. Basin. Water is diverted in field upstream to inlet.

Warner –

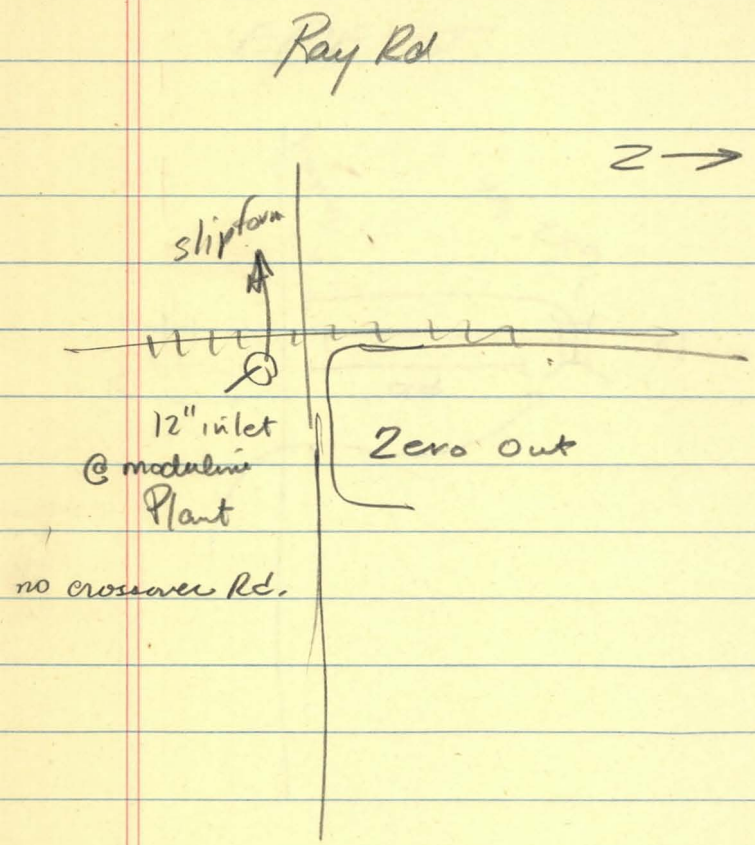
Drainage divide

no underflow

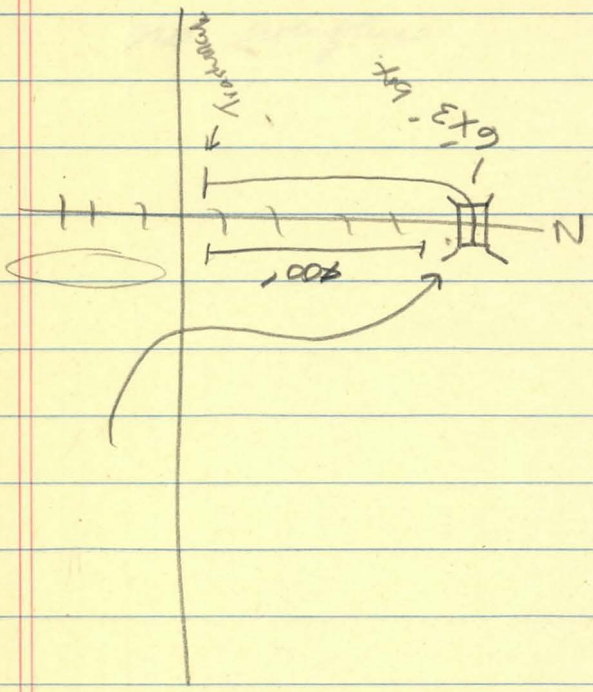
Knox Rd



TAILWATER ditch
very mud SA with
~~12~~ 18" pipe under
track


Ray Rd
Z →
slipform
12" inlet
@ modular
Plant
Zero Out
no crossover Rd.

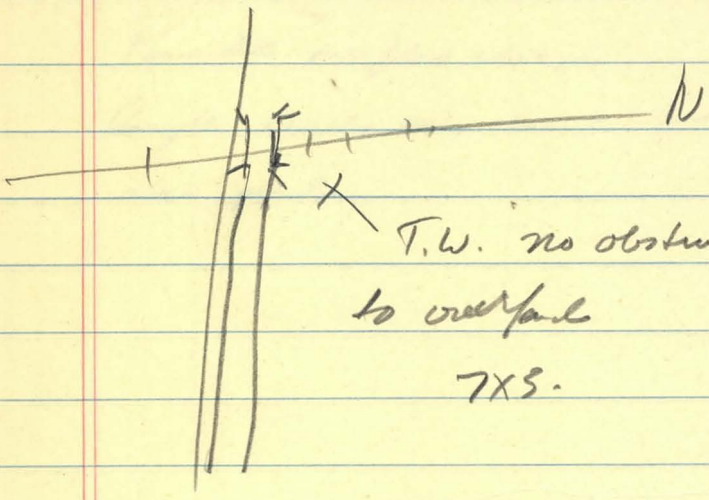
ERIE ST.



Williams Field

no overflow

Commonwealth Ave



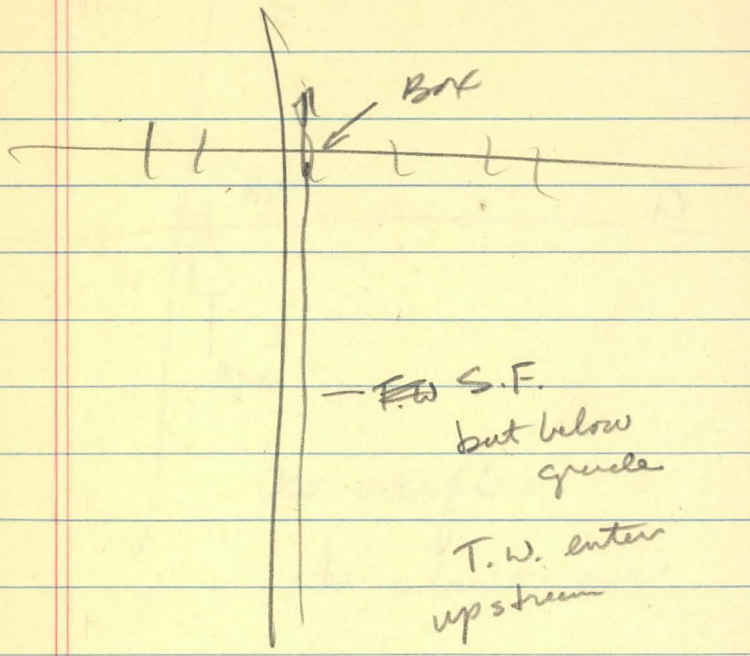
Frye to Commonwealth

Possible overflow along

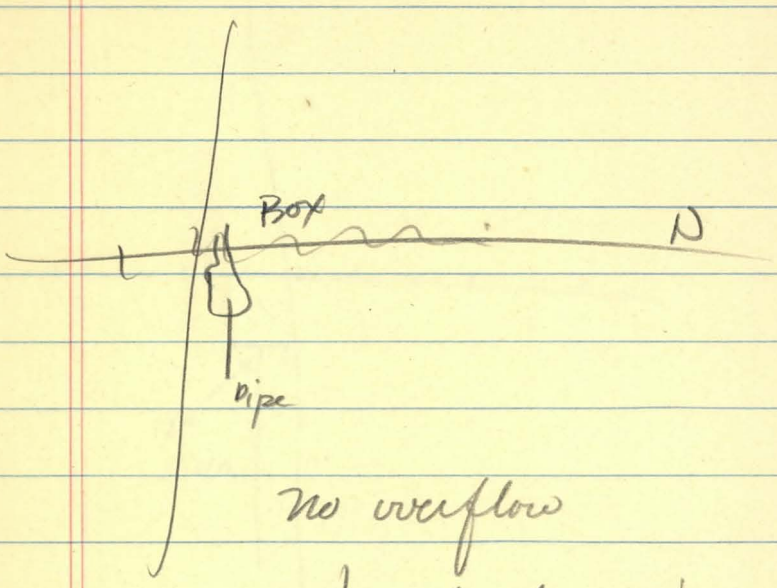
length - tracks only about 1 foot

above grade

Pecos R.

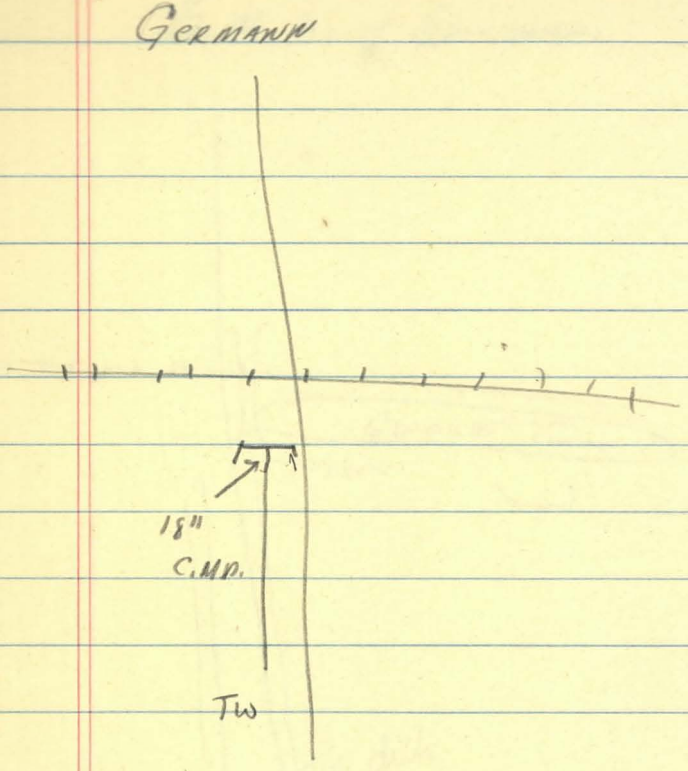


SS of Pear

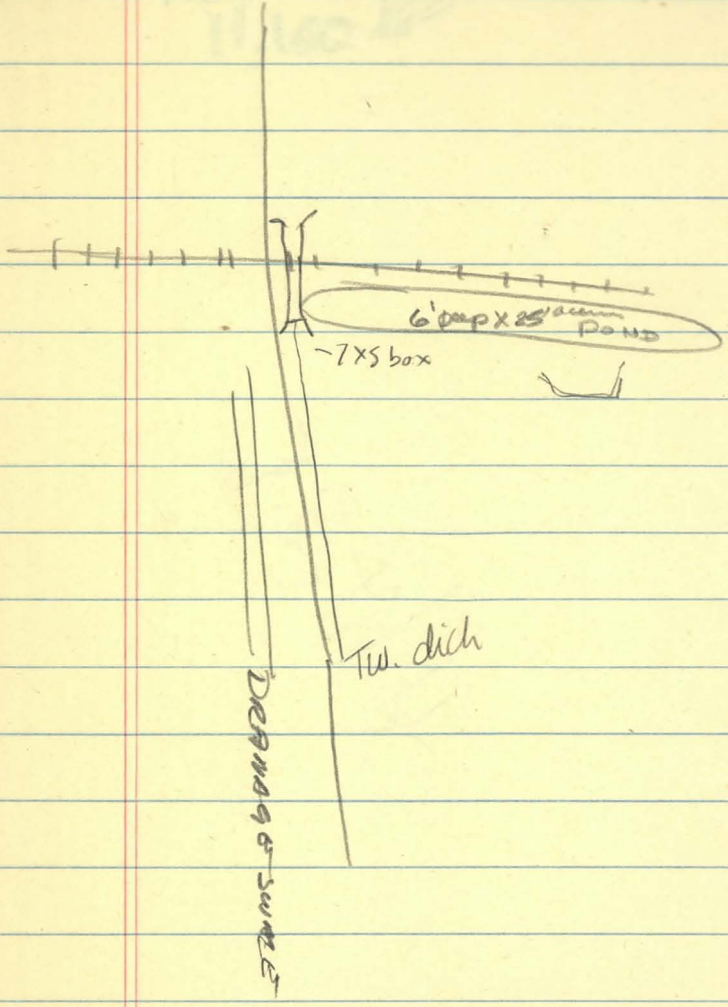


No overflow

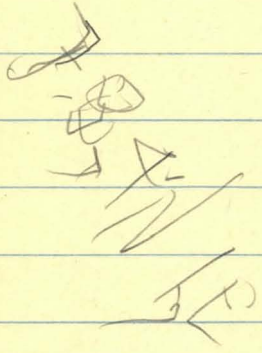
to about 2-3'


GERMANY
18"
C.MD.
TW

½ M. S. of Germania



11,100

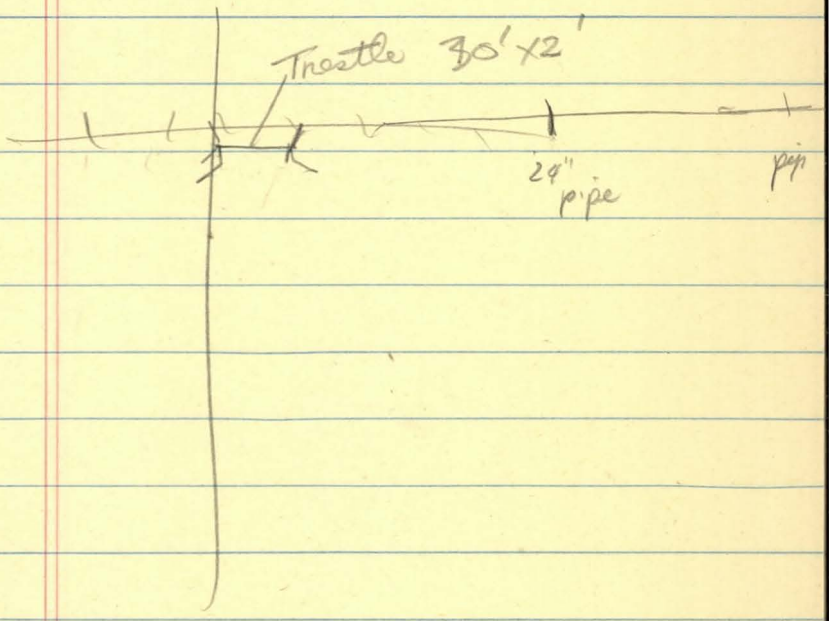


Ocotillo.

10 X 5 Box with guinea
Chanell

Ch. Height Rd

Road high.



Memo for the Record

Subject: Gila Drain Hydrology

Prompted by a question from Dick Pearce, Town Engineer for Gilbert, I have examined the Gila Drain Hydrology performed by the Corps to see if the volumes they included in their report are adequate for design of detention areas. My concern was that a longer, less intense storm might yield higher runoff volumes.

In their study, the Corps abstracted the first two inches of rainfall for surface storage and then used a logarithmic function to calculate the infiltration rate after that abstraction had been met. Plate 38

of their study shows the Standard Project and 100-year storm hyetographs with the initial two-inch storage. Figure 1 below is a copy of this plate which also shows, for the 100-year storm, the loss to infiltration. Note that this is for a seven-hour storm. The excess precipitation provides the future volume shown by the Corps in their report.

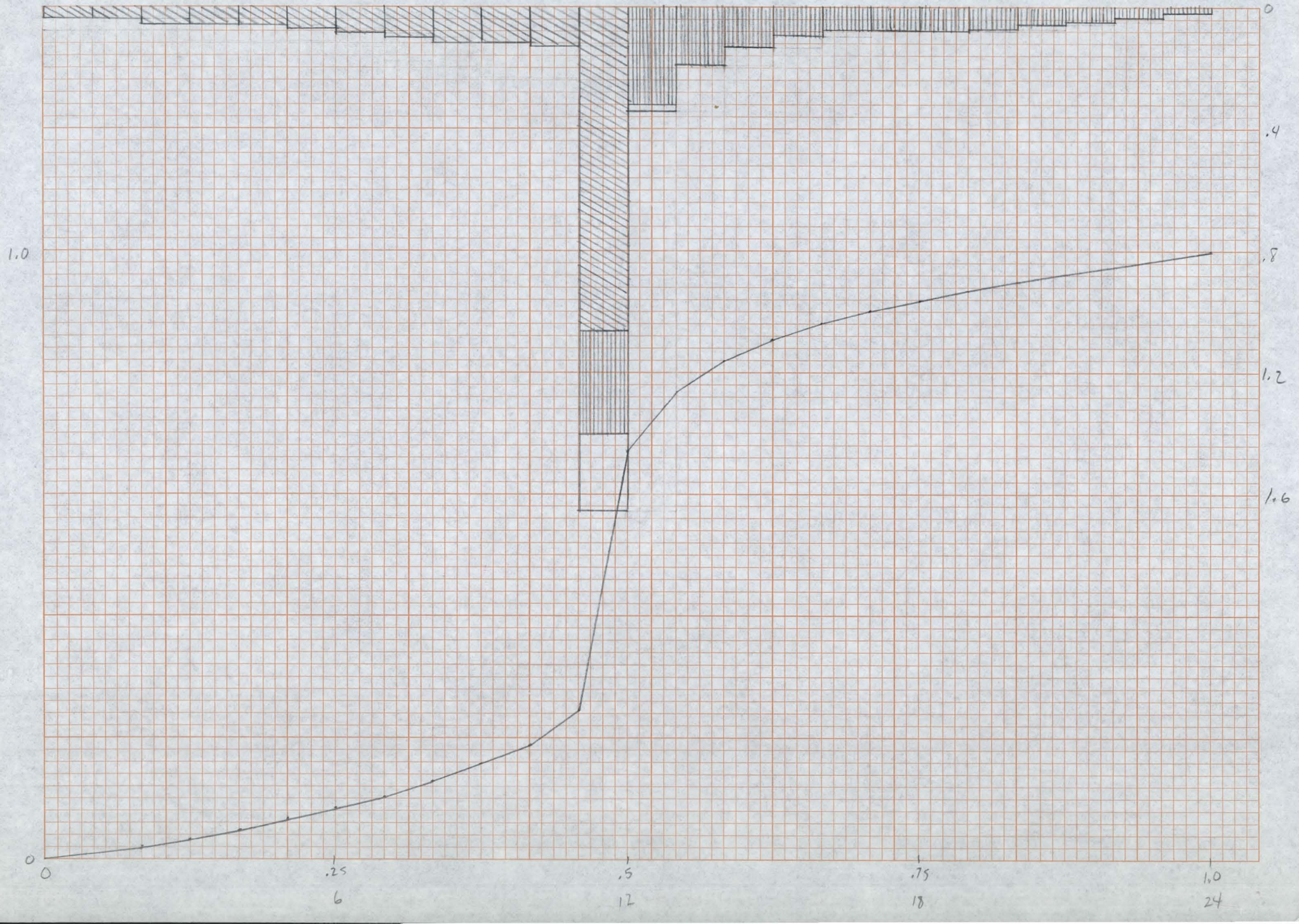
Pl Figure 2 below shows a hyetograph derived from the S-curve for the Corps 7-hour hyetograph. The hyetograph is for a 24-hour, 100-year storm and shows the same initial two inch storage, and infiltration losses calculated by the Corps method. The resulting excess precipitation is lower than that resulting from the seven-hour storm. Tables 1 and 2 show the figures for these storms.

A similar analysis was performed using the Type II storm distribution recommended by the SCS for Arizona. Figure 3 and Table 3 show that the excess rainfall is lower than that derived from the Corps S-curve.

P This indicates to me that the volumes used by the Corps are representative of the worst 100-year storm for this watershed. The infiltration rates may be too high, but a 50% reduction in those rates still yields a lower volume of runoff for the 24-hour storm than those used in the Corps study.

LAB

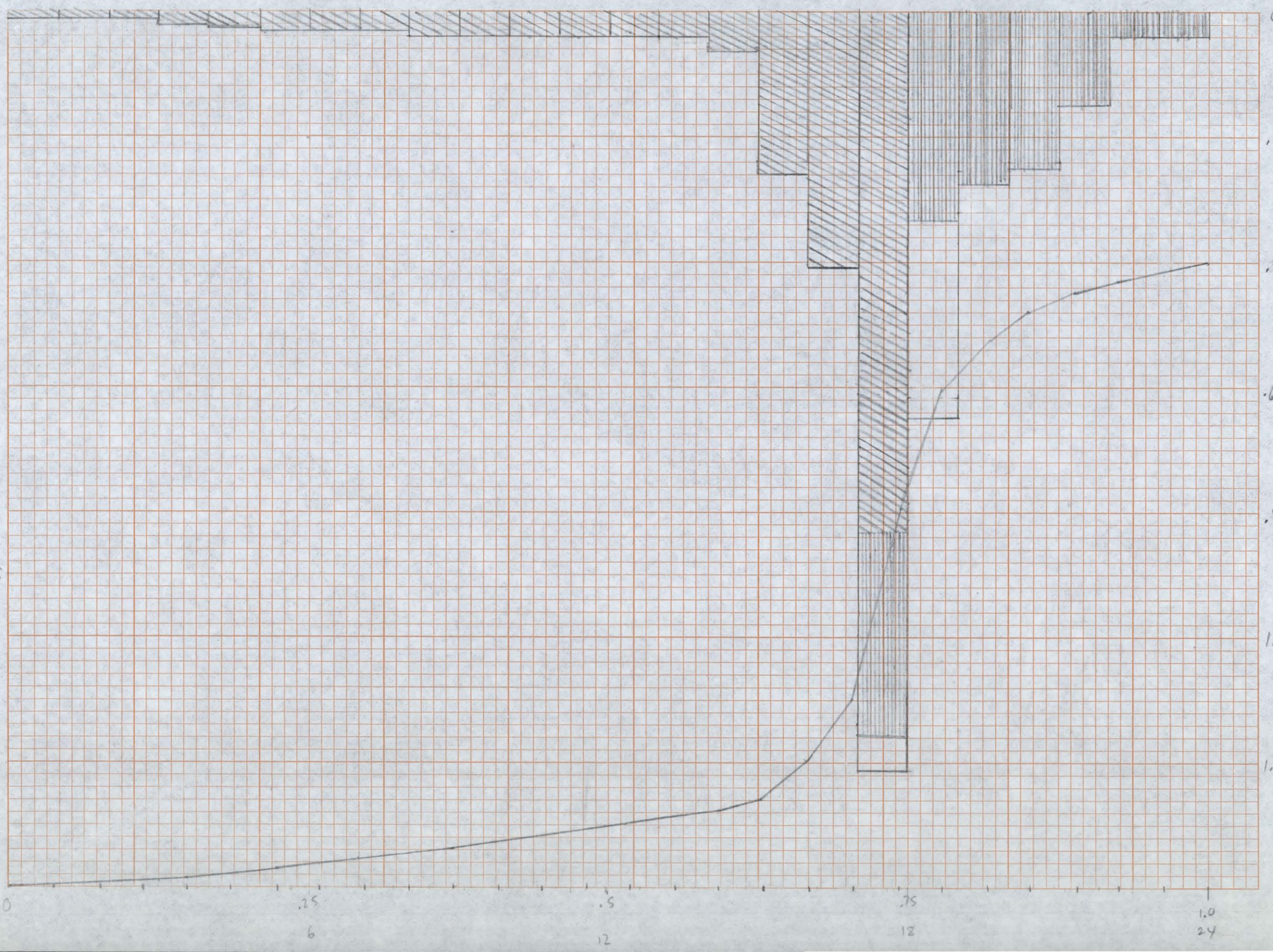
K&E 10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.



K&E 10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 0703

CORPS



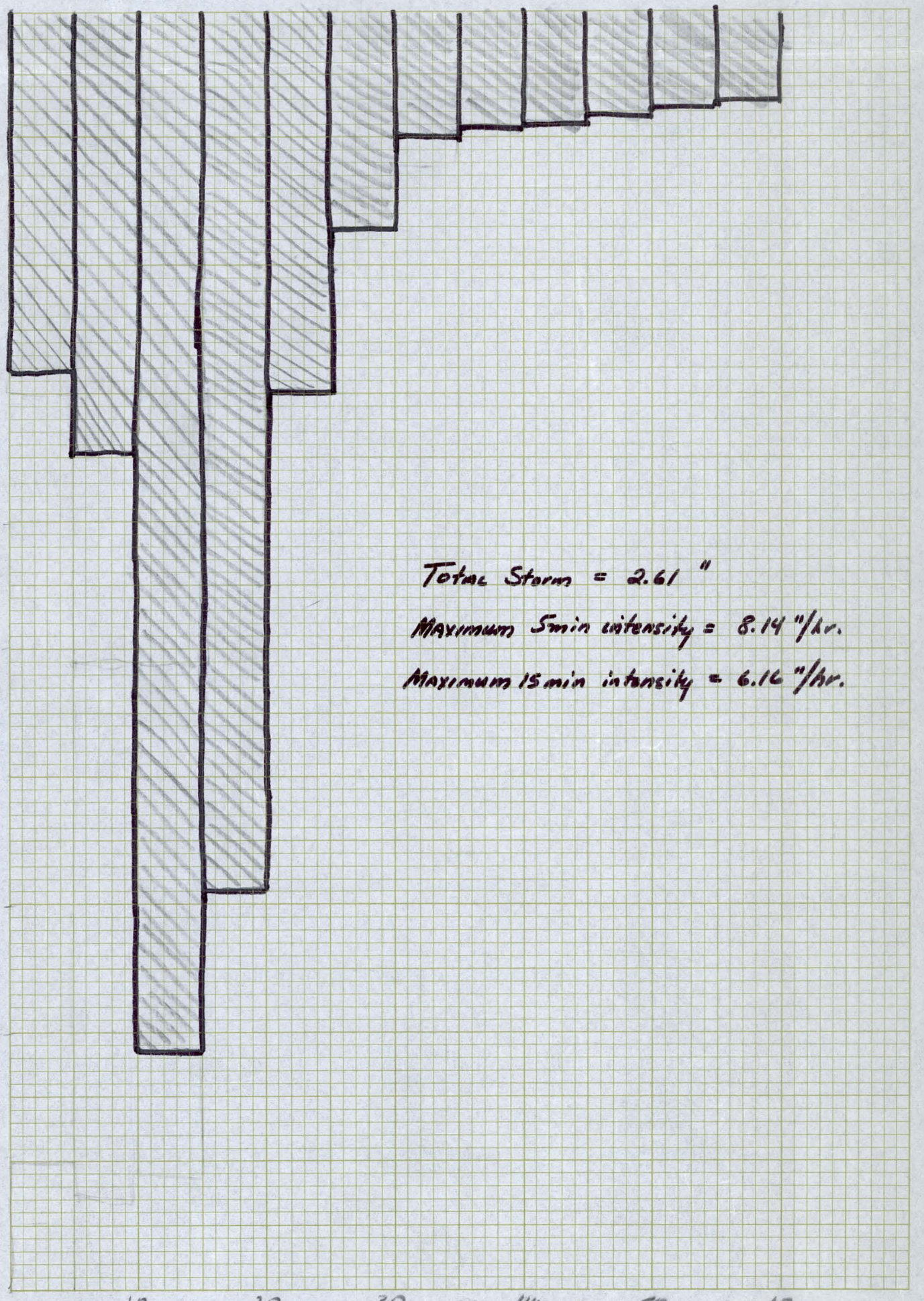
Corps

T	P	S*	L*	P-S-L	Σ(P-S-L)
1	.016	.016	0	0	0
2	.016	.016	0	0	0
3	.016	.016	0	0	0
4	.021	.021	0	0	0
5	.024	.024	0	0	0
6	.033	.033	0	0	0
7	.033	.033	0	0	0
8	.033	.033	0	0	0
9	.041	.041	0	0	0
10	.041	.041	0	0	0
11	.041	.041	0	0	0
12	.041	.041	0	0	0
13	.041	.041	0	0	0
14	.041	.041	0	0	0
15	.065	.065	0	0	0
16	.260	.260	0	0	0
17	.408	.408	(2.0)	0	0
18	1.214	.932	.330	.055	.055
19	.652	0	.320	.332	.387
20	.274	0	.274	0	.387
21	.247	0	.247	0	.387
22	.156	0	.156	0	.387
23	.041	0	.041	0	.387
24	.041	0	.041	0	.387
	3.80	2.00			

SCS

T	P	S*	L*	P-S-L	Σ(P-S-L)
1	.038	.038	0	0	0
2	.038	.038	0	0	0
3	.057	.057	0	0	0
4	.057	.057	0	0	0
5	.057	.057	0	0	0
6	.065	.065	0	0	0
7	.087	.087	0	0	0
8	.095	.095	0	0	0
9	.114	.114	0	0	0
10	.114	.114	0	0	0
11	.209	.209	(2.0)	0	0
12	1.653	1.069	.330	.254	.254
13	.342	0	.324	.018	.272
14	.190	0	.190	0	.272
15	.133	0	.133	0	.272
16	.095	0	.095	0	.272
17	.076	0	.076	0	.272
18	.076	0	.076	0	.272
19	.076	0	.076	0	.272
20	.068	0	.068	0	.272
21	.053	0	.053	0	.272
22	.046	0	.046	0	.272
23	.034	0	.034	0	.272
24	.023	0	.023	0	.272
	3.80	2.00	1.524	.272	.272

HYETOGRAPH 100 YEAR - 1 HOUR STORM



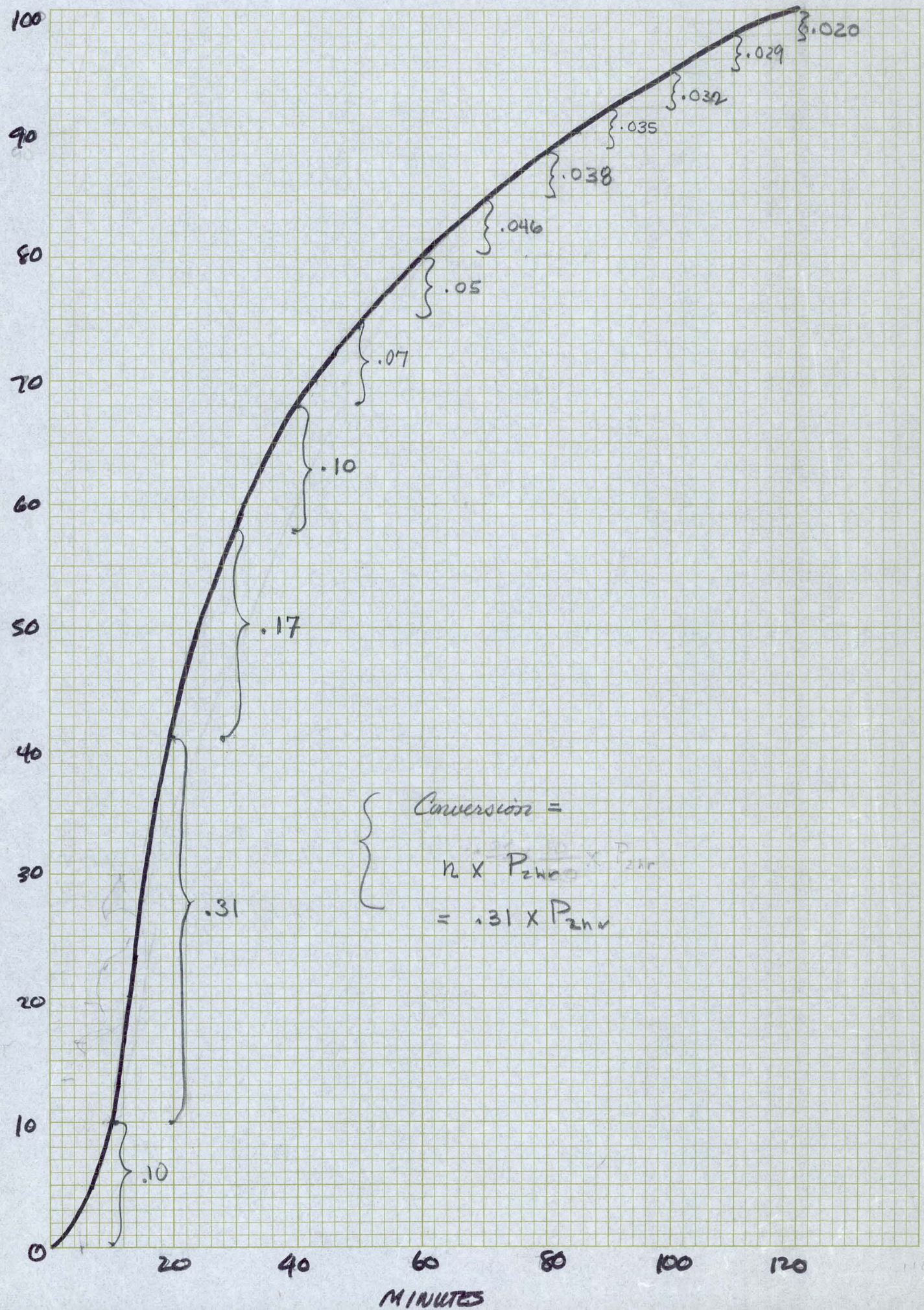
Total Storm = 2.61 "

Maximum 5 min intensity = 8.14 "/hr.

Maximum 15 min intensity = 6.16 "/hr.

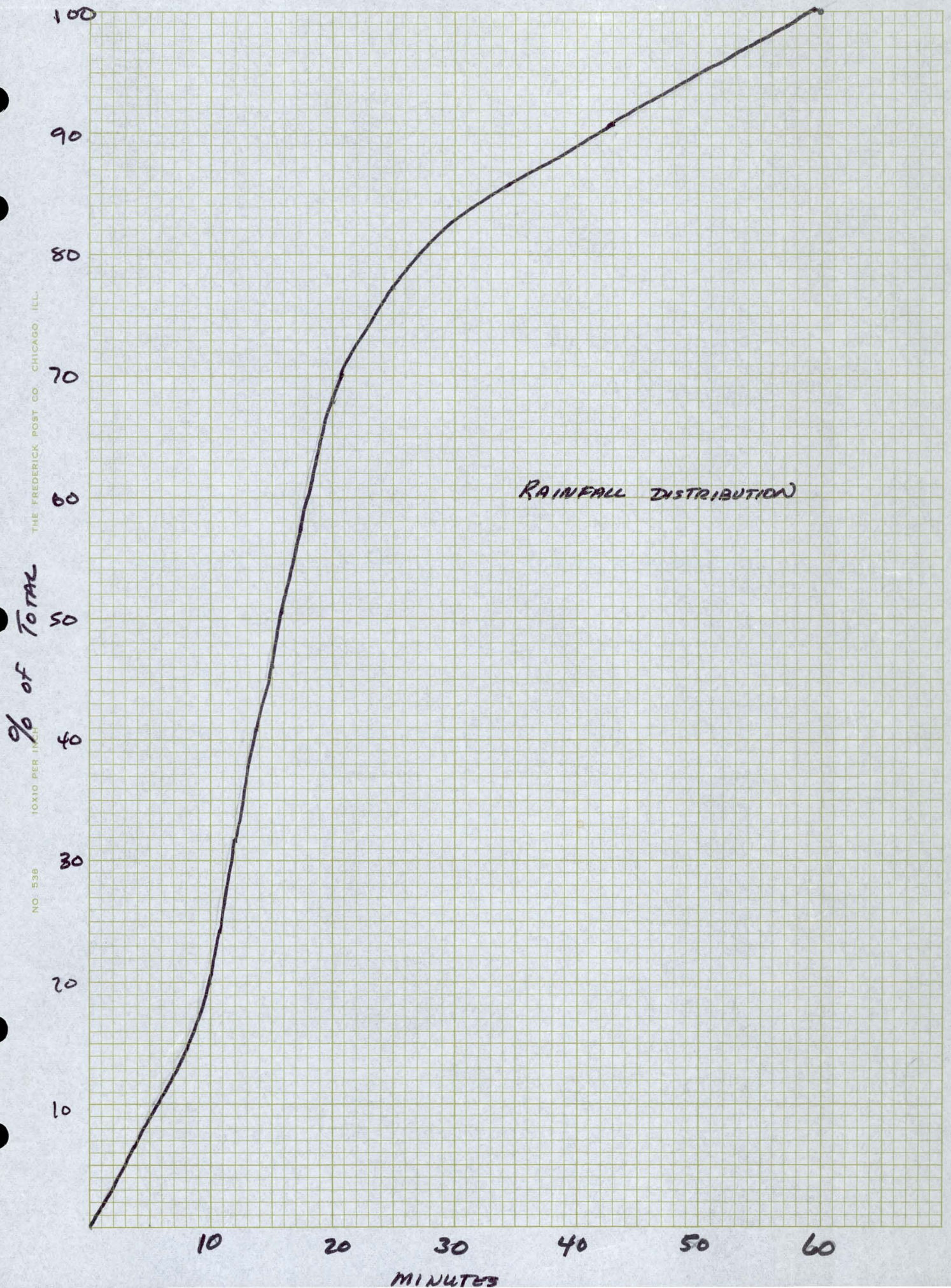
NO. 538 10X10 PER INCH KEUFFEL & ESSER CO. CHICAGO, ILL.

2 HR.



THE FREDERICK POST CO. CHICAGO, ILL.
NO. 538 10X10 PER INCH

1-HR.



NO. 538 10X10 PER INCH THE FREDERICK POST CO. CHICAGO, ILL.

1 HR. Distribution Factors

A	B	C
Time (minutes)	1/100 ths of total	B X 12
0-5	.09	1.08
5-10	.11	1.32
10-15	.26	3.12
15-20	.22	2.64
20-25	.095	1.14
25-30	.055	.66
30-35	.031	.372
35-40	.029	.348
40-45	.028	.335
45-50	.026	.312
50-55	.025	.300
55-60	.023	.275

2.36 x 2.61 = 6.16

1 hr Intensities

100 yr 1 hr = 2.61 inches total

Period	Avg. Intensity inch/hr.
~~2.82~~	
0-5	2.82
5-10	3.45
10-15	8.14
15-20	6.89
20-25	2.98
25-30	1.72.
30-35.	.97
35-40	.91
40-45	.871
45-50	.81
50-55	.78
55-60	.77.

Avg

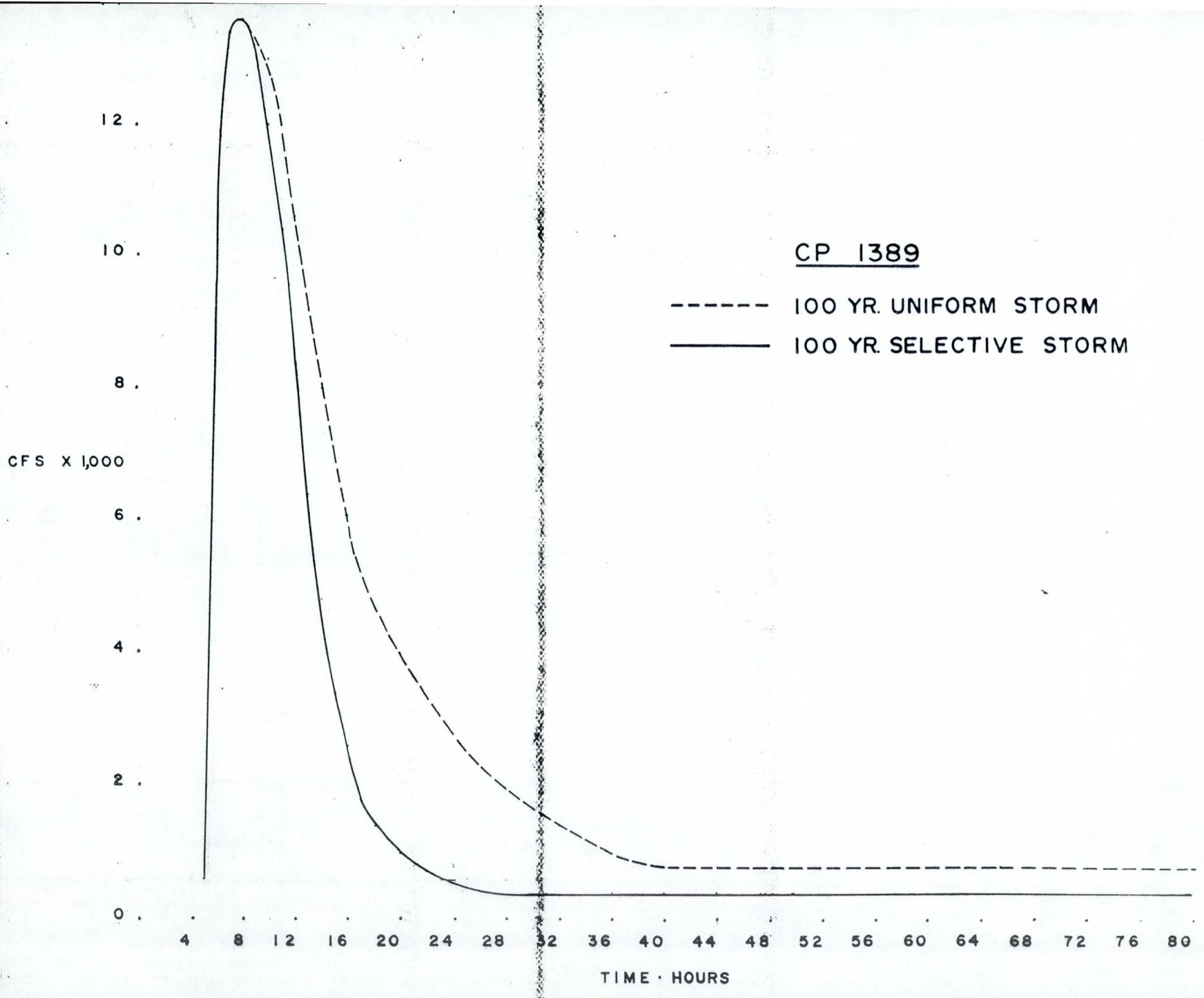
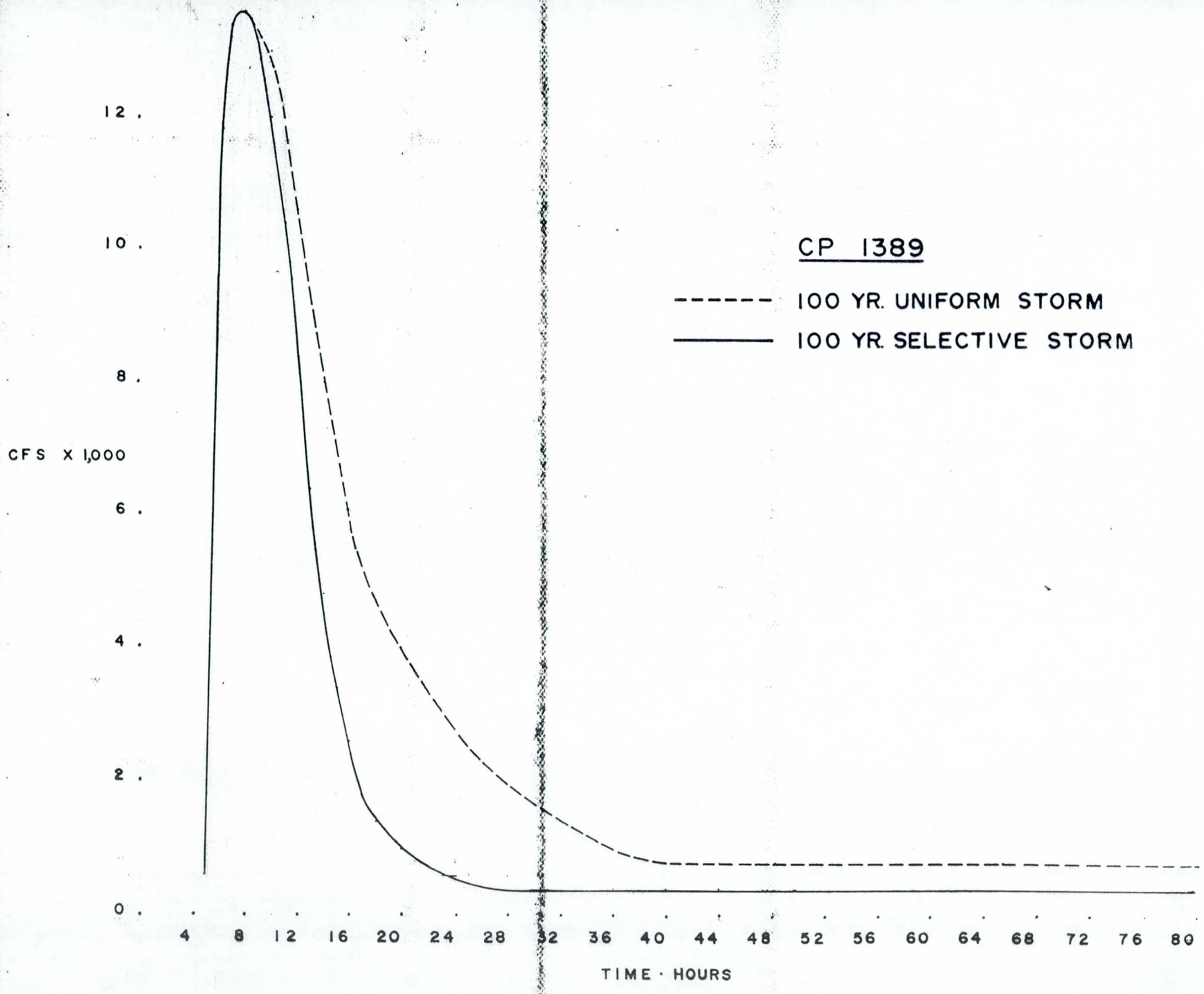
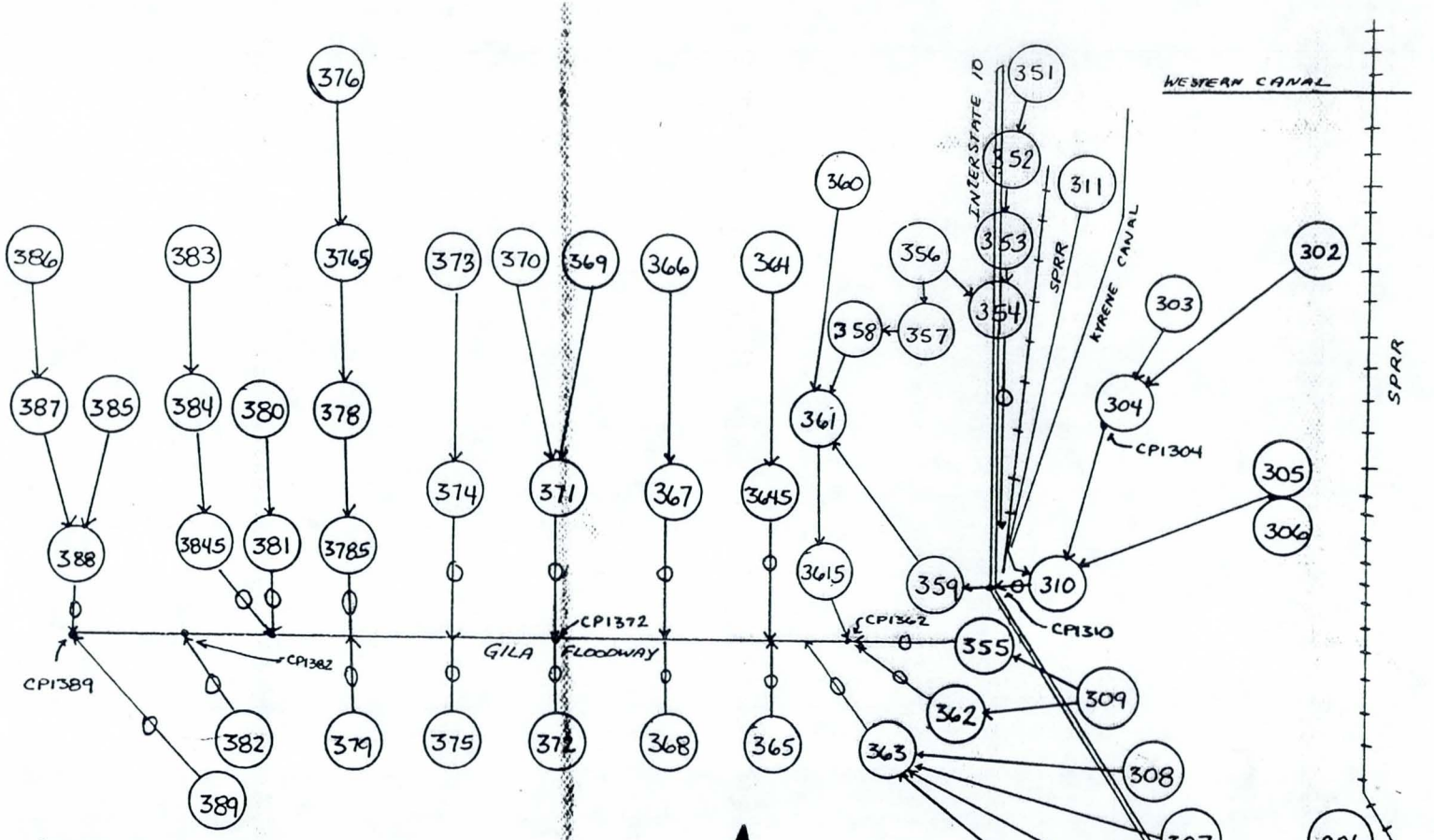

CP 1389
100 YR. UNIFORM STORM
100 YR. SELECTIVE STORM
CFS X 1,000
12.
10.
8.
6.
4.
2.
0.
4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68 72 76 80
TIME · HOURS

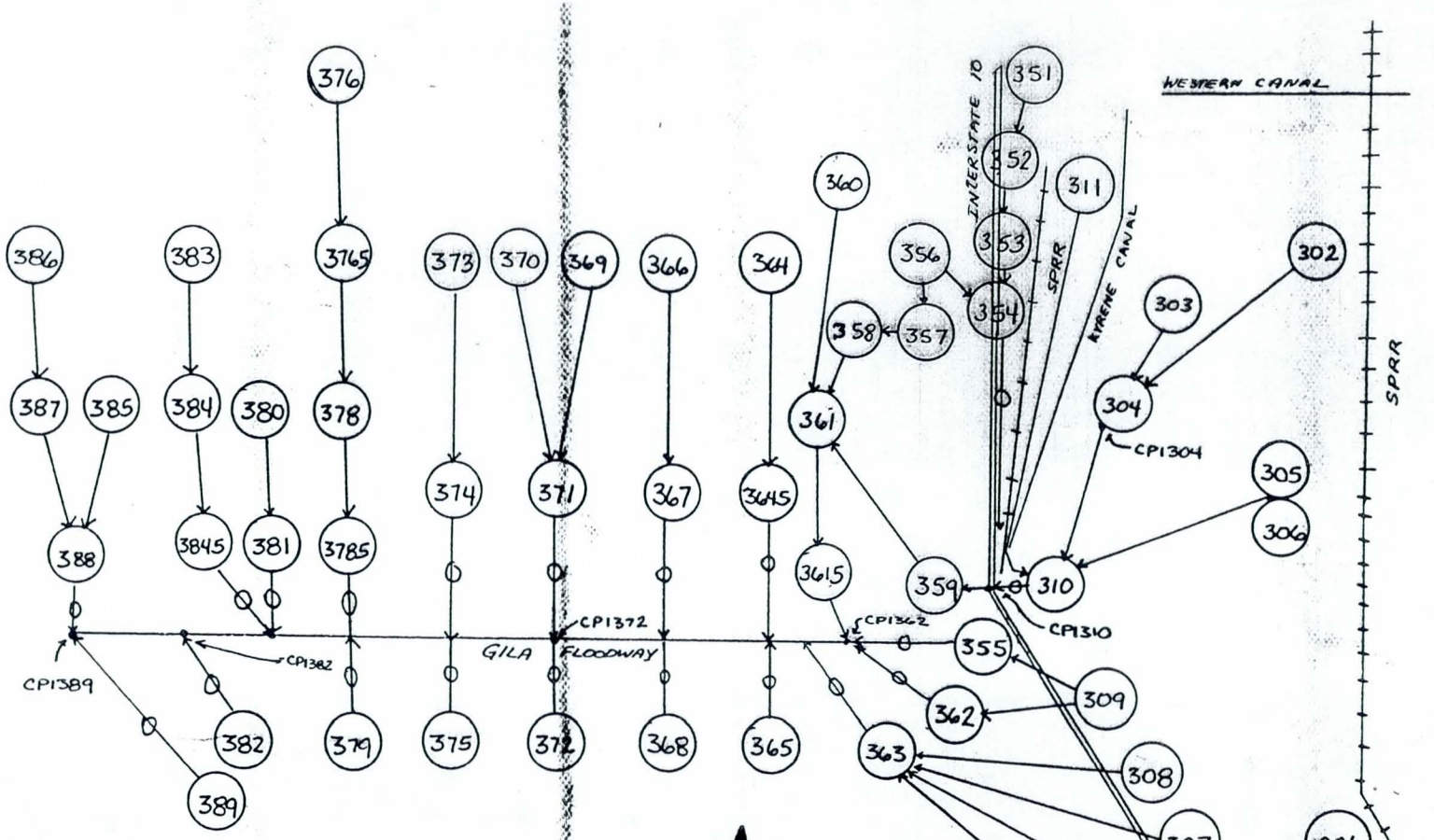
TABLE 2

Comparison of Peak Discarges Using
FCD HEC-1 and 1977 COE Report
(100 Year)

LOCATION	FCD HEC-1	CORPS OF ENGINEERS (1977)
CP 1220	923	550
CP 1225	2052	not given
CP 1304	1077	400
CP 1310	Not comparable - different routing	
CP 1362	8679	3100
CP 1372	11856	4000
CP 1382	12993	4100
CP 1389	13807	not considered


CP 1389
100 YR. UNIFORM STORM
100 YR. SELECTIVE STORM
CFS X 1,000
12.
10.
8.
6.
4.
2.
0.
4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68 72 76 80
TIME · HOURS


376
386
383
3765
373
370
369
366
364
360
351
352
353
354
356
357
358
311
302
303
304
305
306
387
385
384
380
378
361
374
371
367
3645
3615
359
310
388
3845
381
3785
CP1372
CP1362
CP1310
CP1304
CP1389
CP1382
GILA FLOODWAY
355
309
362
382
379
375
372
368
365
363
308
307
906
905
389
INTERSTATE 10
SPRR
KYRENE CANAL
WESTERN CANAL
SPRR
LEGEND
302 SUBAREA
ROUTING REACH
ZERO ROUTING
CP 1389 CONCENTRATION POINT
N
PLATE
GILA DRAIN PROJECT
SCHEMATIC FLOW DIAGRAM
AREA WEST OF SPRR - END OF STUDY
9/30/82


376
386
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376S
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370
369
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351
352
360
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357
303
302
387
385
384
380
378
361
304
CP1304
305
306
374
371
367
364S
388
3845
381
378S
361S
359
310
CP1310
CP1372
CP1362
CP1382
CP1389
GILA FLOODWAY
355
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382
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375
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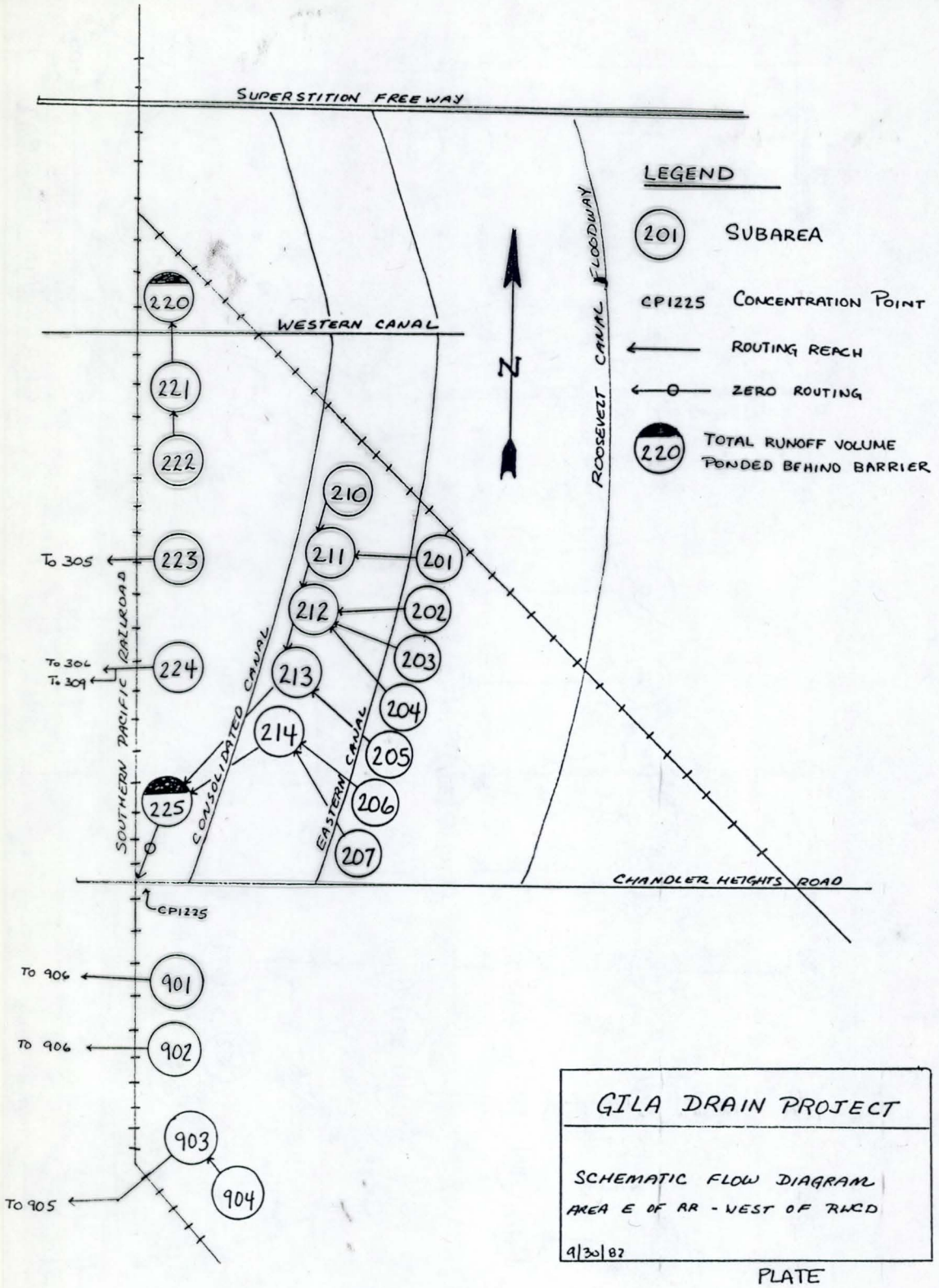
368
365
363
308
307
906
905
INTERSTATE 10
SPRR
KYRENE CANAL
WESTERN CANAL
SPRR
LEGEND
302 SUBAREA
ROUTING REACH
ZERO ROUTING
CP 1389 CONCENTRATION POINT
N
PLATE
GILA DRAIN PROJECT
SCHEMATIC FLOW DIAGRAM
AREA WEST OF SPRR - END OF STUDY
9/30/82



GILA DRAIN PROJECT

SCHEMATIC FLOW DIAGRAM
AREA E OF AR - WEST OF RWCD

9/30/82

PLATE

INCHES RAINFALL - UNIFORM STORM

0.5	1.0	1.5	2.0	2.5	3.14
40	79	119	159	374	903
0	0	0	0	547	2052
0	0	0	0	287	1077
30	104	783	2038	3856	6530
22	563	1809	3466	5618	8679
23	652	2396	4755	7727	11856
23	687	2500	5139	8549	12993
23	719	2624	5430	9056	13807

INCHES RAINFALL - SELECTIVE STORM

0.5	1.0	1.5	2.0	2.5	3.14
0	0	0	1	1	1
0	0	0	0	0	0
0	0	0	0	0	0
17	85	763	1796	2998	4530
10	549	1763	3313	5214	7852
10	635	2338	4583	7323	11067
10	673	2456	5134	8536	12957
10	706	2584	5425	9042	13780

INCHES RAINFALL - UNIFORM STORM

0.5	1.0	1.5	2.0	2.5	3.14
40	79	119	159	374	903
0	0	0	0	547	2052
0	0	0	0	287	1077
30	104	783	2038	3856	6530
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INCHES RAINFALL - SELECTIVE STORM

0.5	1.0	1.5	2.0	2.5	3.14
0	0	0	1	1	1
0	0	0	0	0	0
0	0	0	0	0	0
17	85	763	1796	2998	4530
10	549	1763	3313	5214	7852
10	635	2338	4583	7323	11067
10	673	2456	5134	8536	12957
10	706	2584	5425	9042	13780

INCHES RAINFALL - UNIFORM STORM

LOCATION	0.5	1.0	1.5	2.0	2.5	3.14
CP 1220	40	79	119	159	374	903
CP 1225	0	0	0	0	547	2052
CP 1304	0	0	0	0	287	1077
CP 1310	30	104	783	2038	3856	6530
CP 1362	22	563	1809	3466	5618	8679
CP 1372	23	652	2396	4755	7727	11856
CP 1382	23	687	2500	5139	8549	12993
CP 1389	23	719	2624	5430	9056	13807

INCHES RAINFALL - SELECTIVE STORM

LOCATION	0.5	1.0	1.5	2.0	2.5	3.14
CP 1220	0	0	0	1	1	1
CP 1225	0	0	0	0	0	0
CP 1304	0	0	0	0	0	0
CP 1310	17	85	763	1796	2998	4530
CP 1362	10	549	1763	3313	5214	7852
CP 1372	10	635	2338	4583	7323	11067
CP 1382	10	673	2456	5134	8536	12957
CP 1389	10	706	2584	5425	9042	13780

INCHES RAINFALL - UNIFORM STORM

LOCATION	0.5	1.0	1.5	2.0	2.5	3.14
CP 1220	40	79	119	159	374	903
CP 1225	0	0	0	0	547	2052
CP 1304	0	0	0	0	287	1077
CP 1310	30	104	783	2038	3856	6530
CP 1362	22	563	1809	3466	5618	8679
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INCHES RAINFALL - SELECTIVE STORM

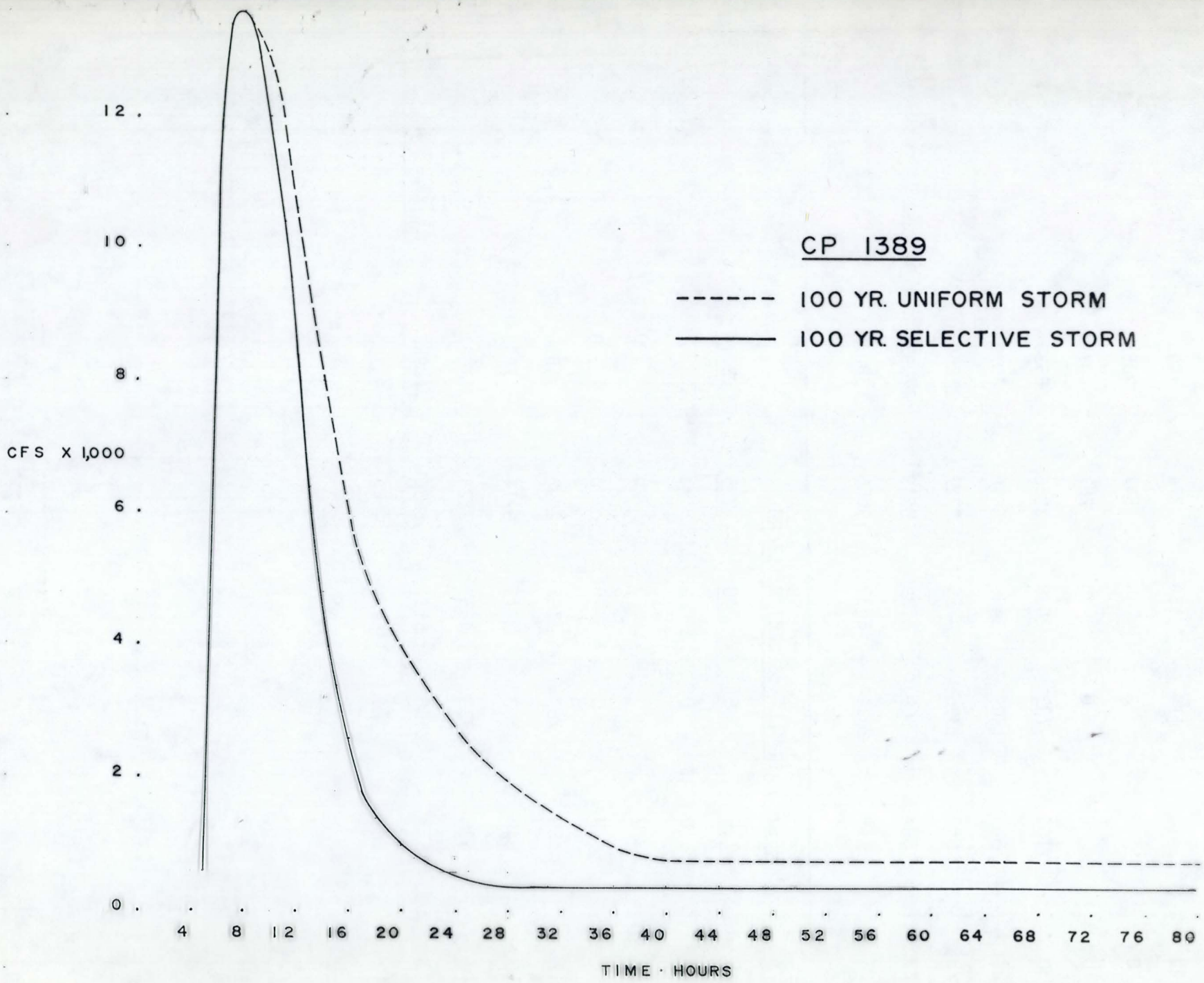
LOCATION	0.5	1.0	1.5	2.0	2.5	3.14
CP 1220	0	0	0	1	1	1
CP 1225	0	0	0	0	0	0
CP 1304	0	0	0	0	0	0
CP 1310	17	85	763	1796	2998	4530
CP 1362	10	549	1763	3313	5214	7852
CP 1372	10	635	2338	4583	7323	11067
CP 1382	10	673	2456	5134	8536	12957
CP 1389	10	706	2584	5425	9042	13780

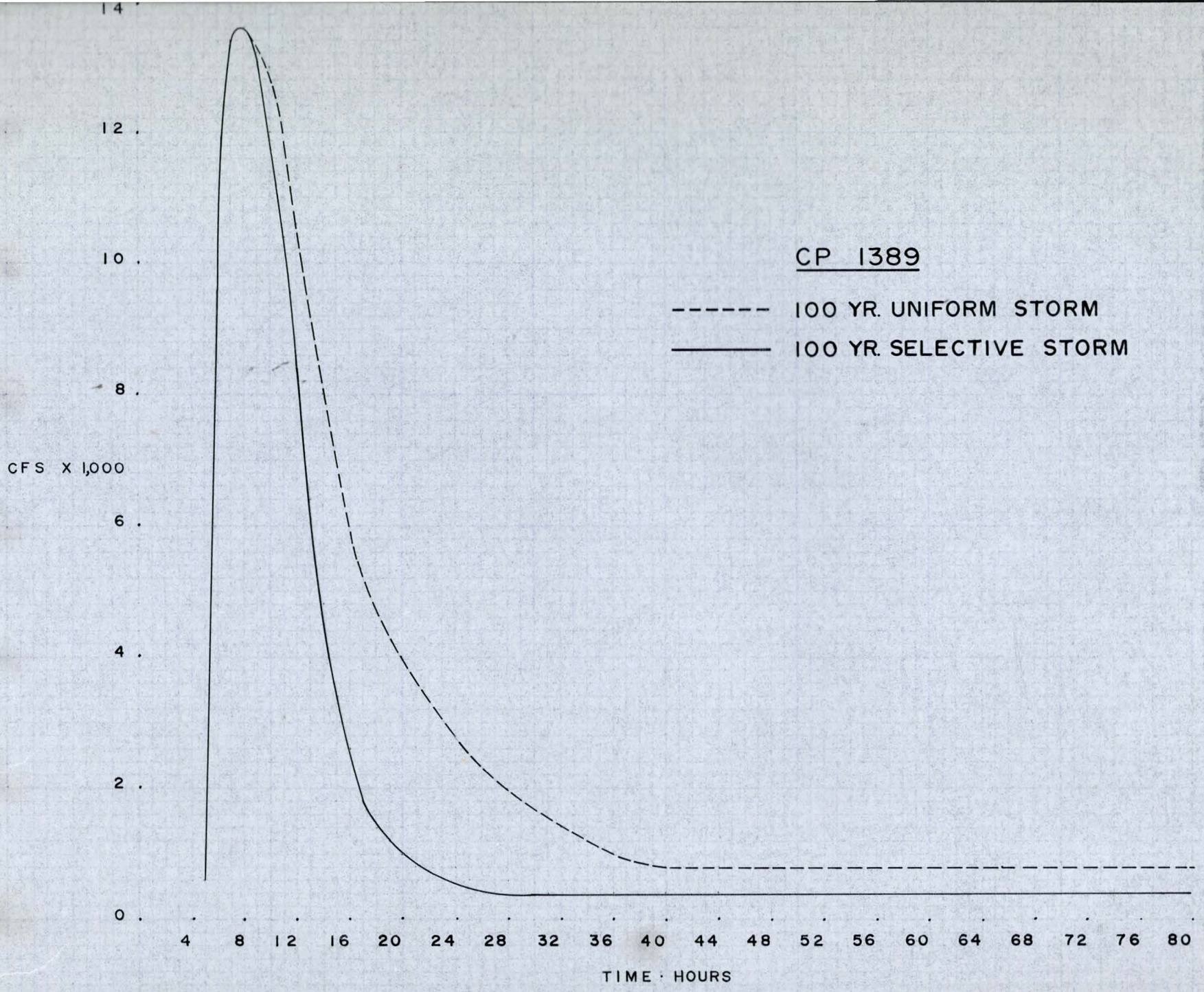
INCHES RAINFALL - UNIFORM STORM

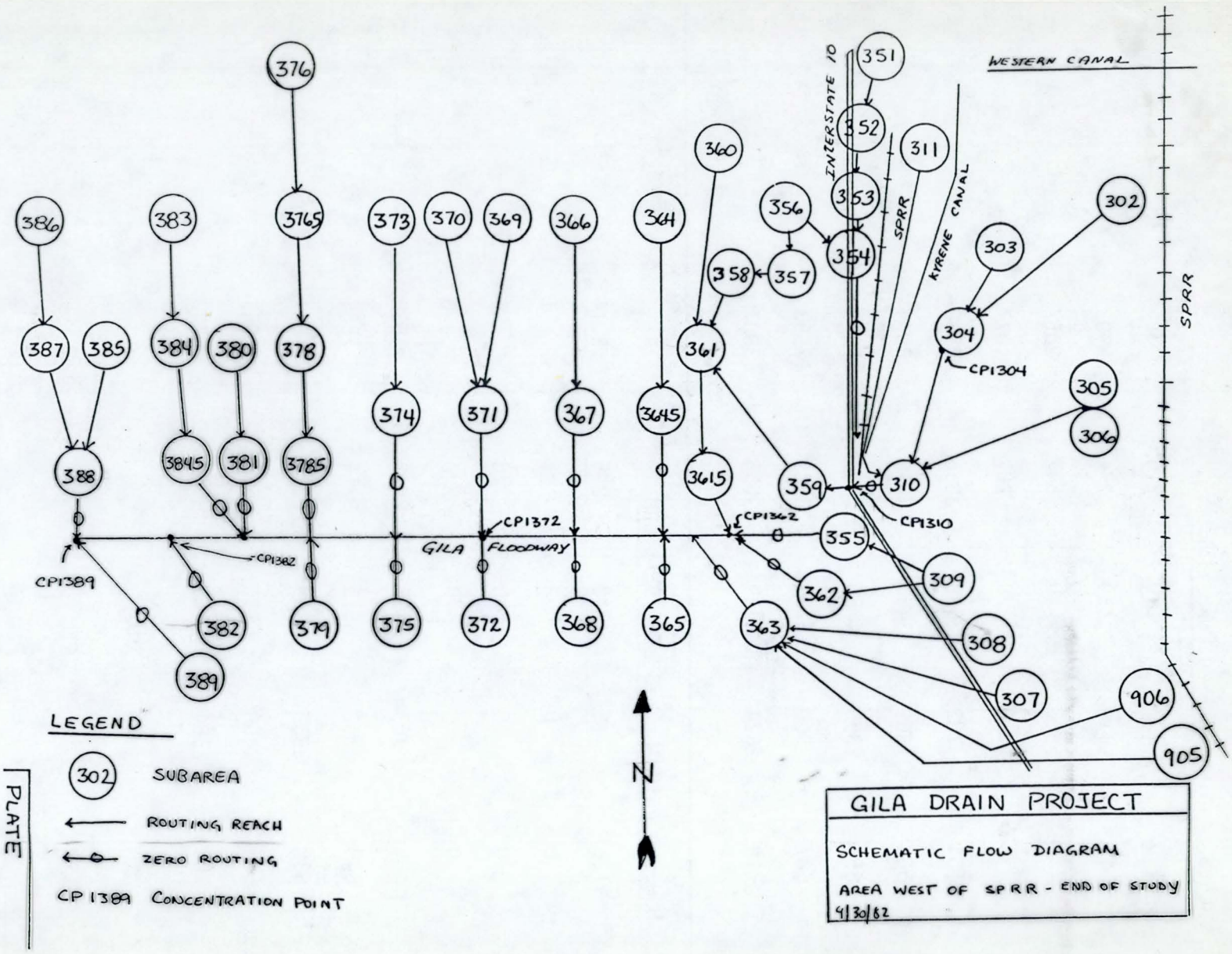
0.5	1.0	1.5	2.0	2.5	3.14
40	79	119	159	374	903
0	0	0	0	547	2052
0	0	0	0	287	1077
30	104	783	2038	3856	6530
22	563	1809	3466	5618	8679
23	652	2396	4755	7727	11856
23	687	2500	5139	8549	12993
23	719	2624	5430	9056	13807

INCHES RAINFALL - SELECTIVE STORM

0.5	1.0	1.5	2.0	2.5	3.14
0	0	0	1	1	1
0	0	0	0	0	0
0	0	0	0	0	0
17	85	763	1796	2998	4530
10	549	1763	3313	5214	7852
10	635	2338	4583	7323	11067
10	673	2456	5134	8536	12957
10	706	2584	5425	9042	13780


CP 1389
100 YR. UNIFORM STORM
100 YR. SELECTIVE STORM
CFS X 1,000
12.
10.
8.
6.
4.
2.
0.
4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68 72 76 80
TIME · HOURS


CP 1389
100 YR. UNIFORM STORM
100 YR. SELECTIVE STORM
CFS X 1,000
14
12
10
8
6
4
2
0
4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68 72 76 80
TIME · HOURS


376
386
383
3765
373
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311
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CP1304
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3645
3615
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CP1310
CP1362
CP1372
355
309
362
363
308
307
906
905
388
3845
381
3785
CP1382
CP1389
382
379
375
372
368
365
389
GILA FLOODWAY
INTERSTATE 10
SPRR
KYRENE CANAL
WESTERN CANAL
SPRR
N
LEGEND
302 SUBAREA
ROUTING REACH
ZERO ROUTING
CP 1389 CONCENTRATION POINT
PLATE
GILA DRAIN PROJECT
SCHEMATIC FLOW DIAGRAM
AREA WEST OF SPRR - END OF STUDY
4/30/82

TABLE 2

Comparison of Peak Discarges Using
FCD HEC-1 and 1977 COE Report
(100 Year)

LOCATION	FCD HEC-1	CORPS OF ENGINEERS (1977)
CP 1220	923	550
CP 1225	2052	not given
CP 1304	1077	400
CP 1310	Not comparable - different routing	
CP 1362	8679	3100
CP 1372	11856	4000
CP 1382	12993	4100
CP 1389	13807	not considered

NHR	NMIN	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	CNEXT	[illegible]
-0	15	-0.	-0.	-0.	-0.	-0.	-0.	2.	-0.

LOCI	NQT	RATIO	IAVHG	NHGT	AVGUG	LNGTH	CONQ
1382	40	-0.00	-0	5	-0.	-0	-0.

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	7.	31.	122.
214.	208.	157.	110.	77.	54.	38.	27.	19.	13.
9.	6.	4.	-0.	-0.	-0.	-0.	-0.	-0.	-0.

	PEAK	6-HOUR	24-HOUR	72-HOUR
FS	214.	46.	11.	7.

ALUE OF OUTFLOW INTERVAL
15 15 15

OMBINED HYDROGRAPH
T 1382 NQ= 160 15-MIN INTRVL

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	1.	37.	167.	659.
1205.	1339.	1351.	1460.	1713.	1952.	2141.	2263.	2325.	2343.
2335.	2316.	2305.	2310.	2349.	2421.	2529.	2673.	2846.	3039.
3251.	3463.	3662.	3836.	3975.	4073.	4124.	4131.	4097.	4028.
3932.	3817.	3691.	3562.	3435.	3316.	3207.	3112.	3030.	2962.
2908.	2865.	2831.	2804.	2782.	2760.	2736.	2707.	2671.	2626.
2571.	2505.	2428.	2342.	2247.	2145.	2038.	1927.	1814.	1700.
1588.	1478.	1372.	1271.	1175.	1085.	1001.	923.	851.	785.
725.	669.	619.	573.	531.	493.	459.	427.	398.	372.
347.	325.	305.	286.	268.	252.	237.	222.	209.	196.
184.	173.	163.	153.	144.	135.	127.	120.	112.	106.
100.	94.	88.	83.	78.	73.	69.	65.	61.	57.
54.	50.	47.	44.	41.	38.	35.	32.	29.	26.
24.	21.	19.	17.	15.	13.	11.	9.	8.	7.
6.	4.	4.	3.	2.	2.	1.	1.	1.	0.

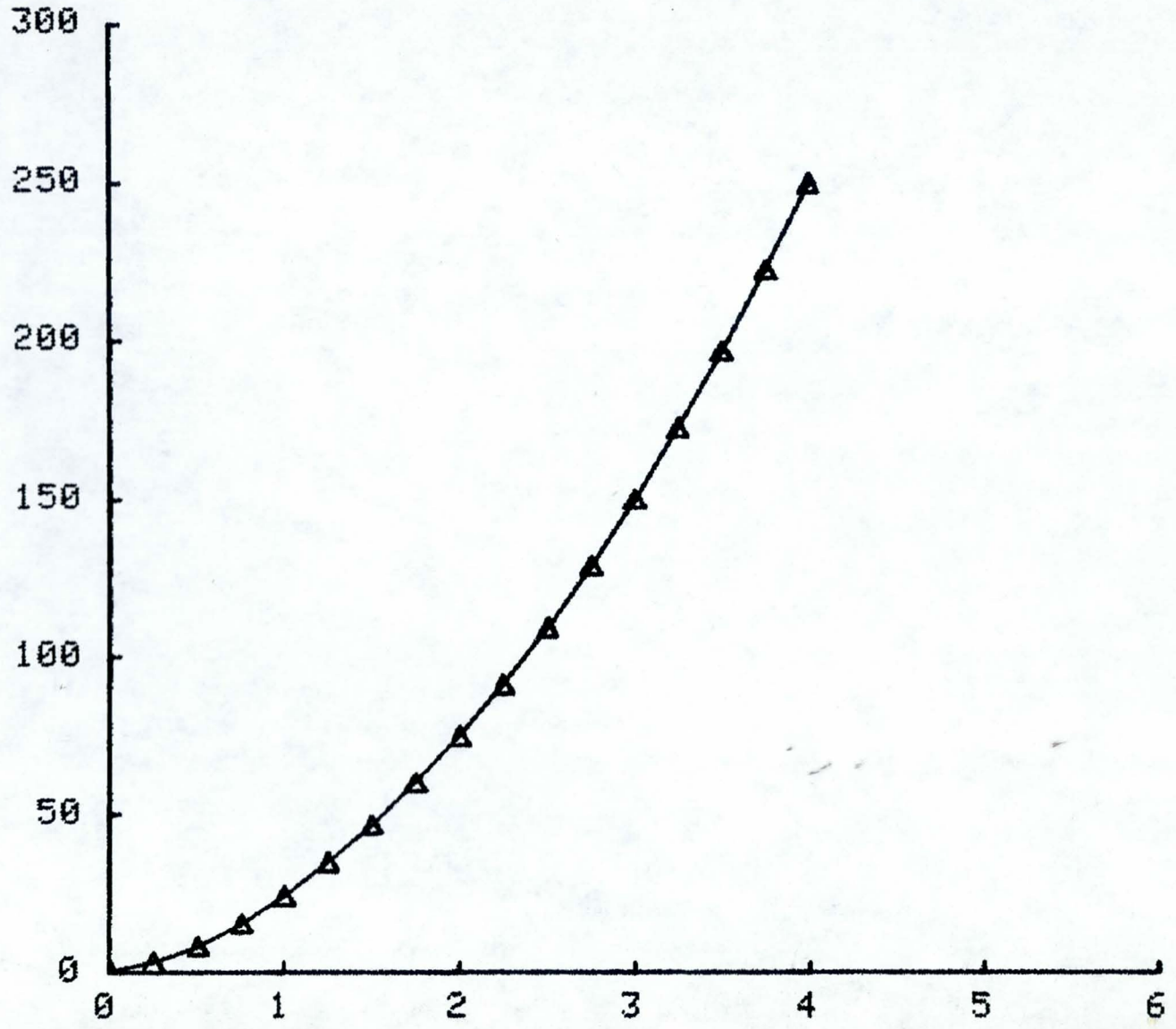
100-Yr. Flood Hydrograph @ CP1382
Present Conditions

	PEAK	6-HOUR	24-HOUR	72-HOUR
FS	4131.	3515.	1941.	1178.

RUNOFF SUMMARY, AVERAGE CFS

		PEAK	6-HOUR	24-HOUR	72-HOUR
YDROGRAPH AT	1365	3169.	2612.	1234.	742.
OUTED TO	1368	2996.	2588.	1233.	742.
YDROGRAPH AT	1366	970.	163.	41.	24.
OUTED TO	1367	357.	162.	41.	24.
YDROGRAPH AT	1367	678.	239.	62.	37.
2 COMBINED	1367	678.	378.	102.	61.
YDROGRAPH AT	1368	234.	106.	29.	18.
3 COMBINED	1368	3393.	2920.	1364.	821.
OUTED TO	1372	3274.	2698.	1363.	821.
YDROGRAPH AT	1369	596.	98.	25.	15.
OUTED TO	1371	228.	98.	25.	15.
YDROGRAPH AT	1370	429.	67.	17.	10.
OUTED TO	1371	181.	67.	17.	10.
YDROGRAPH AT	1371	848.	297.	76.	46.
3 COMBINED	1371	848.	456.	118.	71.
YDROGRAPH AT	1372	181.	53.	13.	8.
[illegible]	1372	3789.	3157.	1486.	900.

$Q = 3.08 \times 7 \times h^{1.5} + 2.44 \times 1.0 \times h^{2.5}$



GILA FLOODWAY OVERFLOW STUDY

Ponding areas between S.P. Railroad going to Chandler and Superstition Freeway divided by S.P. Railroad branch going to Gilbert with Western Canal as a southern boundary.

S.P.F. OVERFLOW ANALYSIS

A. Ponding area bounded by freeway on north and S.P. Railroad going to Gilbert.

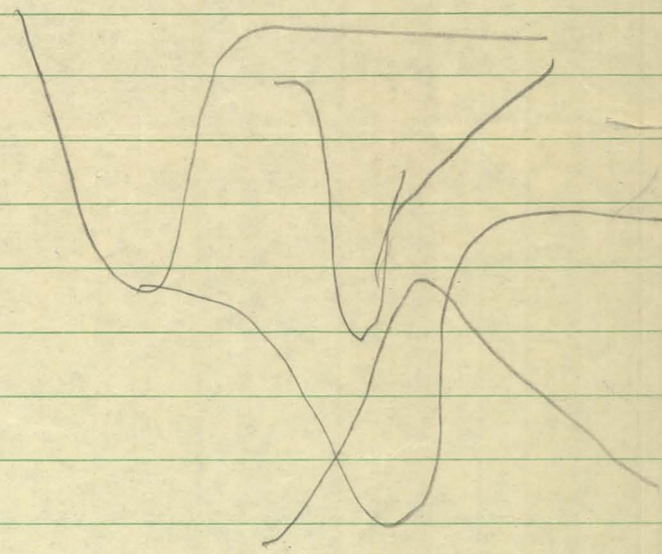
The flow into this ponding area includes the R.W.C.D. overflow. The peak flow is 4500 cfs with a volume of 4300 acre-feet for present conditions. For future conditions, peak flow is 4600 cfs with a volume of 4285 acre-feet. Because there is more volume than the ponding area can hold, the flow will weir over the S.P. Railroad branch going to Gilbert and get into the ponding area south of tracks. The maximum elevation of this pond is 1214.81 feet for both present and future conditions. The weir length is 3800 feet. This flow will combine with the flow coming into subarea 220 (ponding area bounded by S.P. Railroad going to Chandler,on the S.P. Railroad branch going to Gilbert with Western Canal on south).

B. Ponding area bounded by both branches of S.P. Railroad and Western Canal on the south. The present condition inflow is 3400 cfs with a volume of 1075 acre-feet. Future condition inflow is 3000 cfs with a volume of 1165 acre-feet. This flow will combine with the weir flow over the S.P. Railroad branch going to Gilbert. Again the volume of both inflows far exceeds the ponding capacity of the area, and therefore, the flow will weir over the tracks. The flow will then head west and spread out in the area bounded by the freeway on the north, Western Canal on the south, and Tempe Canal on the west. Peak weir outflow for present conditions is 4600 cfs with a volume of 4243 acre-feet. Peak weir outflow for future conditions

Intensity Factors (2HR)

10 minute intervals.

min	factor
0 - 10	~~60~~ .600
10 - 20	~~1.86~~ 1.86
20 - 30	1.02
30 - 40	.600
40 - 50	.420
50 - 60	.300
60 - 70	.275
70 - 80	.228
80 - 90	.210
90 - 100	.192
100 - 110	.174
110 - 120.	.120



= .9 ~~X6000~~ vou

(3.27)

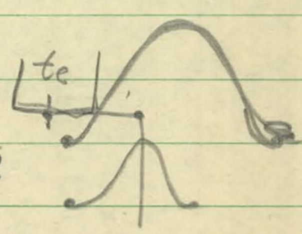
5 min Interval

IF (VOLIN(I) - VOLW(OUT)

0 - 5	.360	85 - 90	.180 ~~IF(VOLIN(I) VOL~~
5 - 10	.840	90 - 95	.162
10 - 15	2.16	95 - 100	.156
15 - 20	1.68 (< max 15)	100 - 105	.150
20 - 25	1.20	105 - 110	.148
25 - 30	.72	110 - 115	.140
30 - 35	.70	115 - 120	.116,
35 - 40	.48	~~120~~	
40 - 45	.42		
45 - 50	.36		
50 - 55	.324		
55 - 60	.288		
60 - 65	.276		
65 - 70	.258		
70 - 75	.228		
75 - 80	.218		
80 - 85	.192		

.995

(VOLOUT(I) G.E. .995)



1.95

2.2.
1.9

not max = (1.92)

SRP- 600 cfs? at head of Gila Drain

SRPOPR.	325	for 2 hours after storm
Tempe WTP	62	
Mesa Motorola	130	uncontrolled
	517	
? Baseline Pump ditch	50	(est) (Stapley Dr.)
? Other (eg storm water	50	(est)
	617	

Mesa - 200 cfs included 130 from Motorola
remaining 70 can be detained as needed

SRP - max in canal from Consolidated to Price - 125 cfs (Gilbert) canal might need to be lined for continuous flows

Tempe - Elliot + Warner + Lag? + Gila Drain → 200 cfs uncontrolled

GILA DRAIN PROJECT

HEC-1 : GUADALUPE DAM WATERSHED ANALYSIS

LINEAR RESERVOIR SHEETFLOW MODEL OUTPUT

HEC HYDROGRAPH COMBINING AND ROUTING PROGRAM MANUAL

0.	0.	0.	0.	0.	0.	0.	0.	0.	40.
1,37.	192.	174.	144.	119.	99.	82.	68.	56.	46.
38.	32.	26.	22.	18.	15.	12.	10.	8.	7.
6.	5.	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.

PEAK	6-HOUR	24-HOUR	72-HOUR
192.	56.	14.	8.

DE OF OUTFLOW INTERVAL
15 15 15

Peak Adjusted to 4300

FINED HYDROGRAPH
1372 NO= 160 (15-MIN INTRVL)

21.	21.	21.	21.	21.	21.	21.	21.	21.	21.
21.	21.	21.	22.	22.	22.	23.	24.	26.	396.
021.	1393.	1625.	1895.	2221.	2585.	2964.	3328.	3641.	3873.
013.	4067.	4052.	3993.	3912.	3828.	3753.	3695.	3657.	3637.
635.	3647.	3668.	3702.	3744.	3793.	3847.	3903.	3959.	4009.
051.	4082.	4095.	4090.	4065.	4020.	3954.	3864.	3761.	3644.
515.	3376.	3232.	3085.	2936.	2790.	2647.	2510.	2380.	2257.
141.	2031.	1928.	1831.	1739.	1652.	1571.	1494.	1423.	1355.
293.	1234.	1180.	1129.	1081.	1036.	992.	949.	906.	862.
818.	772.	725.	677.	629.	581.	535.	490.	448.	408.
371.	337.	305.	275.	248.	222.	199.	177.	157.	138.
122.	106.	93.	81.	71.	62.	54.	47.	42.	37.
32.	28.	25.	22.	19.	16.	14.	12.	10.	8.
7.	6.	5.	4.	3.	2.	1.	1.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

100-Yr. Flood Hydrograph @ OP1372

Future Conditions

PEAK	6-HOUR	24-HOUR	72-HOUR
4095.	3870.	2152.	1297.

RUNOFF SUMMARY, AVERAGE CFS

		PEAK	6-HOUR	24-HOUR	72-HOUR
DROGRAPH AT	1354	3912.	2772.	1109.	666.
ITED TO	1359	3218.	2694.	1109.	668.
DROGRAPH AT	1359	461.	195.	53.	32.
COMBINED	1359	3255.	2738.	1162.	700.
ITED TO	1361	3175.	2698.	1162.	700.
DROGRAPH AT	1356	1751.	576.	94.	56.
ITED TO	1357	872.	574.	94.	56.
DROGRAPH AT	13571	183.	70.	20.	12.
ITED TO	1357	0.	0.	0.	0.
DROGRAPH AT	13572	183.	70.	20.	12.
ITED TO	1357	183.	70.	20.	12.
COMBINED	1357	909.	433.	114.	68.
ITED TO	1358	820.	425.	114.	68.
DROGRAPH AT	1358	266.	90.	23.	14.
COMBINED	1358	846.	492.	137.	82.
ITED TO	1361	756.	477.	137.	82.
DROGRAPH AT	1360	1683.	533.	83.	50.
ITED TO	1361	762.	531.	83.	50.
DROGRAPH AT	1361	652.	249.	65.	39.
COMBINED	1361	3852.	3279.	1446.	871.
DROGRAPH AT	1355	1075.	482.	133.	80.
DROGRAPH AT	1362	518.	252.	72.	43.
COMBINED	1362	4003.	3465.	1651.	994.
UTED TO	1363	3980.	3458.	1651.	994.
ROGRAPH AT	1365	735.	395.	120.	72.

AT 1701 NO= 120 (15-MIN INTRVL)

8.	22.	35.	47.	58.	71.	84.	96.	108.	118.
128.	137.	147.	156.	165.	172.	192.	258.	398.	1766.
3468.	3859.	3614.	3209.	2830.	2480.	2174.	1908.	1671.	1444.
1250.	1084.	943.	825.	723.	658.	564.	502.	448.	402.
365.	335.	311.	294.	281.	271.	263.	255.	246.	235.
220.	203.	182.	159.	137.	114.	92.	73.	56.	44.
33.	25.	19.	15.	11.	9.	7.	6.	5.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR
CFS	3859.	1538.	442.	354.

RUNOFF SUMMARY, AVERAGE CFS

		PEAK	6-HOUR	24-HOUR	72-HOUR
HYDROGRAPH AT	1602	202.	107.	27.	21.
ROUTED TO	1701	159.	100.	27.	21.
HYDROGRAPH AT	1701	3859.	1515.	416.	332.
2 COMBINED	1701	3859.	1538.	442.	354.

combined hydrograph at 1701 after export (Storm drains ~~were~~ and Hydrograph after 575 CFS = 23,413 CFS

0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	1191
2893	3284	3039	2634	2255	1905	1599	1333	404	869
669	509	368	250	148	63	0	0	0	0

100-Yr. Flood Hydrograph @ 1701
Future Conditions

Δ Excess = 2738 cfs-15min = 57 A.F.

(Previous vol 541) − (New Vol 485) = 56 A.F.

	PEAK	6-HOUR	24-HOUR	72-HOUR
FS	617.	455.	164.	131.

ITOR	ITOD	NCMS	LOCD	TATIM	LAG	NSTRL	NPULS	STORA	RES
15	15	1	1753	-0.00	-0	-0	-0	-0.	-0.

ANSWR	X	CLOSS	CCLOS	AMULT	APSCH	JPNCH
-0.000	-0.000	-0.0	-0.000	-0	-0	-0

D ROUTING PERFORMED

NHR	NMIN	IFLAG	PRECIP	RFLAG	HFLAG	BASFLO	PUNCHH	CNEXT	BASEOP
-0	15	-0.	-0.	-0.	-0.	-0.	-0.	2.	-0.

LOCI	NOI	RATIO	IAVHG	AMULT	AVGUG	LNGTH	CONQ
1753	1	-0.00	-0	2	-0.	-0	-0.

0.

	PEAK	6-HOUR	24-HOUR	72-HOUR
FS	0.	0.	0.	0.

ALUE OF OUTFLOW INTERVAL
15 15

OMBINED HYDROGRAPH

T 1753 NO= 120 [15-MIN INTRVL]

0.	1.	1.	1.	2.	2.	3.	2.	3.	3.
3.	3.	4.	3.	4.	4.	5.	7.	12.	71.
130.	150.	126.	68.	80.	32.	53.	12.	56.	19.
35.	11.	11.	11.	5.	7.	1.	0.	0.	2.
14.	57.	142.	262.	387.	492.	563.	602.	617.	616.
604.	586.	565.	542.	518.	494.	471.	448.	426.	406.
386.	367.	348.	330.	313.	296.	281.	266.	253.	240.
228.	216.	205.	194.	184.	174.	164.	155.	145.	136.
127.	119.	110.	102.	93.	85.	77.	69.	62.	54.
47.	40.	34.	28.	22.	16.	11.	7.	4.	3.
1.	1.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

100-Yr. Flood Hydrograph @ CP 1753 present Conditions

	PEAK	6-HOUR	24-HOUR	72-HOUR
CFS	617.	455.	164.	131.

Vol = 325 A.F.

RUNOFF SUMMARY, AVERAGE CFS

		PEAK	6-HOUR	24-HOUR	72-HOUR
HYDROGRAPH AT	1653	703.	476.	154.	123.
ROUTED TO	1753	617.	455.	154.	123.
HYDROGRAPH AT	17531	134.	34.	9.	7.
ROUTED TO	1753	19.	3.	*	*
HYDROGRAPH AT	17532	134.	34.	9.	7.
ROUTED TO	1753	130.	34.	9.	7.
3 COMBINED	1753	617.	455.	164.	131.
HYDROGRAPH AT	1753	0.	0.	0.	0.
2 COMBINED	1753	617.	455.	164.	131.

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

PEAK	6-HOUR	24-HOUR	72-HOUR
871.	870.	121.	73.

TOP	ITOT	NCMS	LOCO	TATAR	LAG	NSTPL	NPULS	STORA	RES
15	15	1	1372	-0.00	-0	-0	-0	-0.	-0.

SAME	X	QLOSS	CLOSS	NHGT	KRNCH	JRNCH
000	-0.000	-0.0	-0.000	-0	-0	-0

OUTING PERFORMED

NHR	NMIN	IFLAG	PRECIP	PELAG	MELAG	BASFLO	PUNCHH	CNEXT	BASEOP
-0	15	-0.	-0.	-0.	-0.	-0.	-0.	2.	-0.

OCI	NCI	RATIO	IAVHG	NHGT	AVGUG	LNGTH	COND
372	50	-0.00	-0	3	-0.	-0	-0.

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	40.
37.	192.	174.	144.	119.	99.	82.	68.	56.	46.
38.	32.	26.	22.	18.	15.	12.	10.	8.	7.
6.	5.	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.

PEAK	6-HOUR	24-HOUR	72-HOUR
192.	56.	14.	8.

E OF OUTFLOW INTERVAL

5 15 15

INED HYDROGRAPH

372 M = 1HR (15-MIN INTRVL)

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	1.	368.
991.	1361.	1590.	1856.	2177.	2534.	2907.	3263.	3567.	3788.
910.	3955.	3922.	3840.	3730.	3610.	3490.	3379.	3279.	3190.
112.	3043.	2981.	2932.	2895.	2871.	2860.	2861.	2871.	2886.
902.	2913.	2913.	2899.	2868.	2818.	2752.	2662.	2563.	2451.
331.	2294.	2073.	1900.	1807.	1677.	1561.	1432.	1319.	1215.
117.	1028.	946.	871.	803.	741.	685.	635.	589.	547.
509.	479.	441.	412.	385.	361.	338.	317.	298.	281.
264.	249.	234.	220.	207.	195.	183.	172.	161.	151.
142.	134.	126.	119.	112.	105.	99.	93.	88.	83.
78.	73.	69.	65.	61.	58.	54.	51.	47.	44.
41.	38.	35.	32.	29.	27.	24.	22.	19.	17.
15.	13.	11.	9.	8.	7.	5.	4.	3.	3.
2.	1.	1.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

100-Yr Flood Hydrograph @ OP 1372
Present Conditions

PEAK	6-HOUR	24-HOUR	72-HOUR
3955.	3298.	1569.	945.

RUNOFF SUMMARY, AVERAGE CFS

		PEAK	6-HOUR	24-HOUR	72-HOUR
ROGRAPH AT	1385	3303.	2722.	1298.	781.
ED TO	1388	3105.	2697.	1297.	781.
ROGRAPH AT	1388	1002.	188.	42.	25.
ED TO	1387	388.	147.	42.	25.

	PEAK	6-HOUR	24-HOUR	72-HOUR
CFS	320.	320.	207.	124.

NHR	NMIN	OFLAG	PRECIP	RFLAG	MFLAG	BASFLO	PUNCHH	CREAT	HASEUP
	15	-0.	-0.	-0.	-0.	-0.	-0.	2.	-0.

LOCI	NOI	RATIO	IAVHG	NHGT	AVGUG	LNGTH	CONQ
1304	1	-0.00	-0	5	-0.	-0	-0.

0.

	PEAK	6-HOUR	24-HOUR	72-HOUR
CFS	0.	0.	0.	0.

VALUE OF OUTFLOW INTERVAL
15 15 15 15 15

COMBINED HYDROGRAPH
AT 1304 NO= 160 15-MIN INTRVL

1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	2.	2.	3.	16.	93.	325.
328.	331.	339.	352.	372.	395.	420.	444.	466.	485.
502.	518.	535.	553.	573.	593.	613.	633.	650.	666.
678.	689.	696.	702.	707.	709.	711.	713.	714.	714.
715.	715.	715.	715.	715.	715.	715.	715.	715.	715.
715.	715.	715.	715.	715.	715.	714.	712.	709.	704.
695.	684.	669.	651.	630.	609.	588.	568.	550.	543.
203.	193.	185.	224.	178.	213.	170.	206.	165.	193.
150.	105.	113.	114.	66.	69.	30.	40.	12.	25.
4.	14.	1.	15.	0.	15.	0.	12.	0.	9.
0.	9.	0.	8.	0.	7.	0.	6.	0.	5.
0.	-2.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

100-Yr Flood Hydrograph @ CP 1304
Future Conditions.

140395 - 836

	PEAK	6-HOUR	24-HOUR	72-HOUR
CFS	715.	714.	420.	252.

RUNOFF SUMMARY, AVERAGE CFS

		PEAK	6-HOUR	24-HOUR	72-HOUR
HYDROGRAPH AT	13021	740.	353.	101.	61.
ROUTED TO	1302	1.	*	*	*
HYDROGRAPH AT	13022	740.	353.	101.	61.
ROUTED TO	1302	235.	235.	101.	61.
2 COMBINED	1302	235.	235.	101.	61.
ROUTED TO	1304	235.	234.	101.	61.
HYDROGRAPH AT	13031	654.	365.	112.	67.
ROUTED TO	1303	0.	0.	0.	0.
HYDROGRAPH AT	13032	654.	365.	112.	67.
ROUTED TO	1303	160.	160.	112.	67.
2 COMBINED	1303	160.	160.	112.	67.
ROUTED TO	1304	160.	160.	112.	67.
HYDROGRAPH AT	13041	997.	624.	207.	124.
ROUTED TO	1304	0.	0.	0.	0.
HYDROGRAPH AT	13042	997.	624.	207.	124.
ROUTED TO	1304	320.	320.	207.	124.
HYDROGRAPH AT	1304	0.	0.	0.	0.
2 COMBINED	1304	715.	714.	420.	252.

	PEAK	6-HOUR	24-HOUR	72-HOUR
FS	155.	155.	63.	38.

NHR	NMIN	IFLAG	PRECIP	RFLAG	HFLAG	BASFLO	PUNCHR	CNEXT	BASEOP
-0	15	-0.	-0.	-0.	-0.	-0.	-0.	2.	-0.

LOCI	NGI	RATIO	IAVHG	NHGT	AVGUG	LNGTH	CONQ
1310	1	-0.00	-0	3	-0.	-0	-0.

0.

	PEAK	6-HOUR	24-HOUR	72-HOUR
FS	0.	0.	0.	0.

ALUE OF OUTFLOW INTERVAL
15 15 15

OMBINED HYDROGRAPH
T 1310 NGE 160 15-MIN INTRVL

8.	10.	13.	15.	19.	23.	28.	33.	39.	46.
53.	61.	70.	80.	90.	101.	114.	135.	208.	520.
877.	936.	1203.	1073.	1141.	1207.	1274.	1346.	1324.	1278.
1452.	1422.	1604.	1573.	1742.	1682.	1962.	2171.	1965.	2134.
1910.	2086.	1855.	1969.	1765.	1927.	1715.	1887.	1707.	1625.
1700.	1796.	1677.	1722.	1657.	1657.	1556.	1509.	1413.	1357.
1256.	1223.	1177.	1151.	1067.	1048.	1016.	992.	965.	946.
922.	902.	879.	856.	836.	811.	784.	757.	728.	689.
656.	572.	503.	458.	343.	340.	309.	288.	271.	257.
245.	233.	219.	203.	186.	164.	142.	123.	102.	86.
72.	60.	50.	44.	35.	29.	26.	23.	20.	18.
16.	14.	12.	11.	9.	8.	7.	6.	6.	5.
5.	4.	4.	4.	3.	3.	3.	3.	3.	2.
2.	1.	1.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

100-Yr. Flood Hydrograph @ CP 13104
Future Conditions

/ 96741 = 1878 CF

	PEAK	6-HOUR	24-HOUR	72-HOUR
CFS	2171.	1820.	941.	567.

RUNOFF SUMMARY, AVERAGE CFS

		PEAK	6-HOUR	24-HOUR	72-HOUR
HYDROGRAPH AT	13021	656.	325.	95.	57.
ROUTED TO	1302	0.	0.	0.	0.
HYDROGRAPH AT	13022	656.	325.	95.	57.
ROUTED TO	1302	235.	235.	95.	57.
2 COMBINED	1302	235.	235.	95.	57.
ROUTED TO	1304	235.	235.	95.	57.
HYDROGRAPH AT	13031	583.	346.	112.	67.
ROUTED TO	1303	0.	0.	0.	0.
HYDROGRAPH AT	13032	583.	346.	112.	67.
ROUTED TO	1303	160.	160.	112.	67.
2 COMBINED	1303	160.	160.	112.	67.
ROUTED TO	1304	160.	160.	112.	67.
HYDROGRAPH AT	13041	922.	592.	205.	124.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

15 15 15 15

MBINED HYDROGRAPH

1310	NO= 160	15-MIN INTRVL							
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	166.
9.	0.	0.	0.	0.	0.	0.	0.	718.	749.
491.	688.	716.	698.	688.	685.	688.	695.	1047.	1028.
793.	848.	905.	957.	1003.	1036.	1053.	1057.	774.	745.
1004.	976.	947.	917.	889.	861.	832.	804.	492.	466.
716.	686.	656.	627.	597.	569.	543.	517.	300.	285.
445.	423.	402.	384.	365.	347.	330.	314.	180.	171.
271.	258.	246.	234.	223.	211.	200.	189.	111.	107.
163.	155.	147.	140.	134.	128.	122.	116.	69.	66.
101.	97.	92.	88.	84.	81.	76.	72.	34.	32.
62.	59.	55.	53.	50.	46.	44.	36.	19.	18.
30.	29.	27.	26.	24.	23.	22.	21.	9.	8.
17.	16.	15.	14.	13.	12.	11.	10.	0.	0.
7.	6.	5.	4.	3.	2.	1.	1.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

100-Yr. Flood Hydrograph @ OP 1310A
Present Conditions

	PEAK	6-HOUR	24-HOUR	72-HOUR
CFS	1057.	890.	415.	251.

RUNOFF SUMMARY, AVERAGE CFS

		PEAK	6-HOUR	24-HOUR	72-HOUR
HYDROGRAPH AT	1302	103.	82.	21.	13.
ROUTED TO	1304	72.	56.	21.	13.
HYDROGRAPH AT	13031	78.	53.	22.	13.
ROUTED TO	1303	94.	56.	14.	9.
HYDROGRAPH AT	13032	76.	53.	22.	13.
ROUTED TO	1303	76.	53.	22.	13.
2 COMBINED	1303	147.	78.	35.	22.
ROUTED TO	1304	90.	75.	36.	22.
HYDROGRAPH AT	1304	137.	100.	45.	28.
3 COMBINED	1304	233.	198.	102.	62.
ROUTED TO	1310	226.	197.	102.	62.
HYDROGRAPH AT	1305	61.	371.	126.	76.
HYDROGRAPH AT	1306	147.	94.	34.	20.
2 COMBINED	1310	357.	465.	160.	96.
ROUTED TO	1310	572.	429.	160.	96.
HYDROGRAPH AT	1311	67.	41.	14.	8.
ROUTED TO	1310	58.	40.	14.	8.
HYDROGRAPH AT	1310	699.	419.	141.	84.
4 COMBINED	1310	1057.	890.	415.	251.

0. 0. 0. 0. 0. 0. 0. 0. 0. 0.
0. 0. 0. 0. 0. 0. 0. 0. 0. 0.

	PEAK	6-HOUR	24-HOUR	72-HOUR
CFS	929.	370.	93.	56.

ITQR	ITQO	NRCHS	LOCO	TATMR	LAG	NSTRL	NPULS	STORA	RES
15	15	1	1382	-0.00	-0	-0	-0	-0.	-0.
AMSKK	X	QLOSS	COLOS	NHGT	KPNCH	JPNCH			
-0.000	-0.000	-0.0	-0.000	-0	-0	-0			

NO ROUTING PERFORMED

NHR	NMIN	IFLAG	PRECIP	RFLAG	HFLAG	BASFLO	PUNCHH	CNEXT	BASEOP
-0	15	-0.	-0.	-0.	-0.	-0.	-0.	2.	-0.

LOCI	NOI	RATIO	IAVHG	NHGT	AVGUG	LNGTH	COND
1382	40	-0.00	-0	3	-0.	-0	-0.

0. 0. 0. 0. 0. 0. 0. 0. 0. 0.
0. 0. 0. 0. 0. 0. 0. 7. 31. 122.
214. 208. 157. 110. 77. 54. 38. 27. 19. 13.
9. 6. 4. -0. -0. -0. -0. -0. -0. -0.

	PEAK	6-HOUR	24-HOUR	72-HOUR
CFS	214.	46.	11.	7.

VALUE OF OUTFLOW INTERVAL
15 15 15

COMBINED HYDROGRAPH
AT 1382 NO= 160 15-MIN INTRVL

21. 21. 21. 21. 21. 21. 21. 21. 21. 21.
21. 21. 21. 21. 21. 21. 21. 55. 182. 669.
1207. 1330. 1330. 1446. 1665. 1894. 2076. 2196. 2261. 2289.
2294. 2294. 2305. 2334. 2396. 2489. 2615. 2772. 2956. 3156.
3372. 3588. 3791. 3970. 4117. 4225. 4290. 4317. 4307. 4269.
4210. 4138. 4062. 3989. 3923. 3868. 3826. 3798. 3784. 3781.
3789. 3803. 3821. 3840. 3856. 3868. 3872. 3865. 3847. 3814.
3768. 3707. 3633. 3546. 3448. 3340. 3224. 3103. 2977. 2850.
2722. 2596. 2472. 2351. 2235. 2123. 2016. 1915. 1819. 1728.
1642. 1562. 1486. 1415. 1348. 1286. 1226. 1170. 1116. 1064.
1014. 965. 916. 868. 821. 773. 726. 679. 633. 588.
544. 501. 460. 421. 384. 350. 317. 286. 258. 231.
207. 185. 164. 145. 128. 113. 99. 87. 76. 66.
58. 51. 44. 38. 34. 29. 25. 22. 19. 17.
14. 12. 10. 9. 7. 6. 5. 4. 3. 2.
2. 1. 1. 1. 0. 0. 0. 0. 0. 0.

100-Yr Flood Hydrograph @ CP1382 Future Conditions

	PEAK	6-HOUR	24-HOUR	72-HOUR
CFS	4317.	3988.	2512.	1530.

0. 0. 0. 0. 0. 0. 0. 0. 0. 0.

GILA DRAIN SURVEY STUDY
100 YEAR FLOOD RDA= 5 SQ MI
SUBAREA 224 DA=3.07 SQ MI PRESENT CONDITIONS (1985)
CP 1224

EFFECTIVE RAINFALL (INCHES/HOUR) 15-MIN INTERVAL

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.45
1.67	.49	0.00	0.00	0.00	0.00	0.00	0.00		

DA	DAC	PIM	CLOSS	ALOSS	RAI	KLOSS	TIME	LENGTH	N	I	SLOPE	K	SPF	KACUM
3.07	3.07	0.00	.40	1.84	3.10	-0	.250	1.90	.070	1.67	.00200	2.079	0.	-0

RUNOFF HYDROGRAPH (CUBIC FEET PER SECOND)

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	50.
283.	494.	494.	438.	388.	344.	305.	270.	240.	213.
188.	167.	148.	131.	116.	103.	92.	81.	72.	64.
57.	50.	44.	39.	35.	31.	27.	24.	22.	19.
17.	15.	13.	12.	10.	9.	8.	7.	6.	6.
5.	5.								

VOLUME IN CFS-15 MIN. = 5145.0

VOLUME IN ACRE-FEET = 106.5

LOCI	NCI	RATIO	IAVG	[illegible]	AVG	LAGIN	[illegible]		
1304	150	-0.00	-0	5	-0.	-0	-0.		
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
74.	187.	224.	218.	211.	205.	198.	192.	186.	181.
175.	170.	164.	159.	154.	150.	145.	140.	136.	132.
128.	124.	120.	116.	113.	109.	106.	103.	99.	96.
93.	90.	86.	85.	82.	80.	77.	75.	73.	70.
68.	66.	64.	62.	60.	58.	56.	55.	53.	51.
50.	48.	47.	45.	44.	43.	41.	40.	39.	38.
36.	35.	34.	33.	32.	31.	30.	29.	28.	27.
27.	26.	25.	24.	23.	23.	22.	21.	21.	20.
19.	19.	18.	18.	17.	17.	16.	16.	15.	15.
14.	14.	13.	13.	13.	12.	12.	11.	11.	11.
10.	10.	10.	9.	9.	9.	9.	8.	8.	8.
8.	7.	7.	7.	7.	6.	6.	6.	6.	6.
6.	5.	5.	5.	5.	-0.	-0.	-0.	-0.	-0.

	PEAK	6-HOUR	24-HOUR	72-HOUR
CFS	224.	164.	74.	46.

VALUE OF OUTFLOW INTERVAL
15 15 15

COMBINED HYDROGRAPH
AT 1304 NO= 160 (15-MIN INTRVL)

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
74.	187.	225.	221.	218.	222.	229.	240.	253.	268.
278.	292.	307.	323.	340.	356.	368.	378.	385.	389.
390.	388.	385.	376.	367.	356.	345.	333.	319.	307.
294.	281.	270.	258.	247.	236.	226.	216.	207.	197.
189.	181.	175.	166.	159.	152.	145.	139.	133.	127.
122.	117.	112.	107.	103.	99.	94.	90.	87.	83.
79.	76.	73.	70.	67.	64.	62.	59.	57.	54.
53.	51.	48.	46.	44.	43.	41.	39.	38.	36.
34.	33.	31.	30.	27.	26.	23.	21.	19.	18.
16.	15.	14.	14.	13.	12.	12.	11.	11.	11.
10.	10.	10.	9.	9.	9.	9.	8.	8.	8.
8.	7.	7.	7.	7.	6.	6.	6.	6.	6.
6.	5.	5.	5.	5.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

100-Yr. Flood Hydrograph @ CP 1304
Present Conditions

	PEAK	6-HOUR	24-HOUR	72-HOUR
CFS	390.	337.	162.	99.

RUNOFF SUMMARY, AVERAGE CFS

		PEAK	6-HOUR	24-HOUR	72-HOUR
HYDROGRAPH AT	1302	168.	102.	35.	21.
ROUTED TO	1304	119.	92.	35.	21.
HYDROGRAPH AT	13051	134.	84.	30.	18.
ROUTED TO	1303	205.	65.	23.	14.
HYDROGRAPH AT	13052	154.	84.	30.	18.
ROUTED TO	1303	134.	84.	30.	18.
2 COMBINED	1303	310.	159.	53.	32.
ROUTED TO	1304	175.	134.	53.	32.
HYDROGRAPH AT	1304	224.	164.	74.	46.

1751 1 -0.00 -0 0 -0. -0 -0.

0.

PEAK 6-HOUR 24-HOUR 72-HOUR
FS 0. 0. 0. 0.

ALUE OF OUTFLOW INTERVAL
15 15 15 15

OMBINED HYDROGRAPH
T 1751 NO= 120 (15-MIN INTRVL)

3.	7.	11.	14.	17.	21.	25.	28.	32.	35.
39.	42.	45.	49.	54.	57.	64.	101.	215.	331.
333.	334.	340.	346.	356.	370.	390.	412.	436.	459.
480.	498.	507.	513.	515.	515.	513.	511.	508.	505.
501.	498.	497.	498.	509.	535.	580.	479.	550.	653.
697.	759.	792.	820.	822.	827.	815.	806.	784.	770.
742.	715.	685.	652.	618.	580.	545.	512.	481.	454.
431.	410.	259.	243.	228.	215.	202.	191.	180.	169.
159.	150.	140.	131.	122.	114.	105.	96.	88.	79.
71.	62.	54.	46.	39.	31.	25.	19.	14.	10.
7.	4.	3.	2.	1.	1.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

100-Yr. Flood Hydrograph @ CP 1751 Future Conditions

PEAK 6-HOUR 24-HOUR 72-HOUR
FS 827. 676. 346. 277.

RUNOFF SUMMARY, AVERAGE CFS

		PEAK	6-HOUR	24-HOUR	72-HOUR
YDROGRAPH AT	1653	628.	427.	137.	110.
YDROGRAPH AT	17531	178.	45.	12.	9.
OUTED TO	1753	25.	2.	*	*
YDROGRAPH AT	17532	178.	45.	12.	9.
OUTED TO	1753	130.	45.	12.	9.
3 COMBINED	1753	628.	427.	149.	120.
OUTED TO	17521	561.	416.	149.	120.
YDROGRAPH AT	16511	697.	231.	61.	49.
OUTED TO	1651	0.	0.	0.	0.
YDROGRAPH AT	16512	697.	231.	61.	49.
OUTED TO	1651	168.	168.	61.	49.
2 COMBINED	1651	168.	168.	61.	49.
OUTED TO	17521	168.	167.	61.	49.
2 COMBINED	17521	729.	539.	211.	169.
OUTED TO	1752	687.	528.	211.	169.
YDROGRAPH AT	17521	708.	265.	78.	62.
OUTED TO	1752	0.	0.	0.	0.
YDROGRAPH AT	17522	708.	285.	78.	62.
OUTED TO	1752	133.	133.	78.	62.
3 COMBINED	1752	820.	661.	288.	231.
YDROGRAPH AT	17511	536.	213.	58.	46.
OUTED TO	1751	0.	0.	0.	0.
YDROGRAPH AT	17512	536.	213.	58.	46.
OUTED TO	1751	183.	183.	58.	46.
YDROGRAPH AT	1751	0.	0.	0.	0.
4 COMBINED	1751	827.	676.	346.	277.

0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0 0 0 0 0 0 0 0 0

PEAK 6-HOUR 24-HOUR 72-HOUR
4095. 1796. 545. 436.

VOL = 29255 CFS 15 MIN = 60

RUNOFF SUMMARY, AVERAGE CFS

		PEAK	6-HOUR	24-HOUR	72-HOUR
ROGRAPH AT	1602	599.	293.	92.	73.
FD TO	1701	341.	265.	92.	73.
ROGRAPH AT	1603	408.	94.	24.	19.
FD TO	1701	203.	94.	24.	19.
ROGRAPH AT	1701	4095.	1577.	430.	348.
OMBINED	1701	4095.	1796.	545.	436.

NMR	NMIN	DTAG	STRTQ	RTAG	RTAG	BASFLO	PUNCHR	CLEXT	BASEOP
=0	=0	=0.	=0.	=0.	=0.	=0.	=0.	=0.	=0.

LOCI	NOI	RATIO	IAVNG	NRGT	AVGNG	LRGTH	COND
=0	=0	=0.00	=0	=0	=0.	=0	=0.

COMBINED HYDROGRAPH-
AT 1701 NQ = 120 (15-min INTP)

← Corrected Combined Hydrograph

8	23	36	48	60	72	55	98	110	120
129	139	149	158	166	174	194	262	405	1906
2731	4095	3811	3368	2957	2581	2256	1978	1739	1522
1347	1212	1102	1027	961	901	842	721	718	658
5981	543	493	450	413	382	355	333	313	298
2852	275	269	264	263	261	259	255	249	240
227	210	192	165	139	114	91	71	49	35
24	16	11	7	4	3	2	1	1	0

$\Sigma \Delta Q$ = VOL 1383 CFS 15 MIN
= 29 AF.

Hydrograph after 575 CFS Export (Storm drains ~~[illegible]~~ accounted)

0									0
0									1331
3156	3520	3236	2793	2382	2006	1681	1403	1164	947
772	637	533	452	386	326	267	206	143	83
23	0								0

VOL = 27447 CFS 15-MIN = 568 AF.

100-Yr. Flood Hydrograph at CP 1701
Present Conditions

Sheet 2

	PEAK	6-HOUR	24-HOUR	72-HOUR
FS	0.	0.	0.	0.

ALUE OF OUTFLOW INTERVAL
15 15 15 15

OMBINED HYDROGRAPH
T 1751 NO= 120 (15-MIN INTRVL)

0.	0.	0.	0.	1.	1.	2.	1.	2.	3.
3.	4.	4.	5.	5.	5.	6.	7.	9.	27.
110.	196.	211.	203.	197.	195.	197.	202.	207.	210.
211.	210.	207.	204.	201.	197.	193.	188.	182.	174.
165.	155.	145.	136.	128.	127.	135.	164.	214.	301.
462.	442.	487.	538.	550.	569.	553.	553.	526.	517.
464.	478.	440.	430.	398.	386.	360.	349.	325.	314.
293.	283.	264.	250.	236.	223.	212.	200.	189.	178.
167.	156.	146.	136.	126.	116.	107.	98.	89.	80.
72.	64.	56.	46.	38.	32.	25.	20.	15.	10.
7.	5.	3.	2.	1.	1.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

100-Yr Flood Hydrograph @ CP 1751
Present Conditions

	PEAK	6-HOUR	24-HOUR	72-HOUR
FS	569.	425.	194.	155.

385 A.F.

RUNOFF SUMMARY, AVERAGE CFS

		PEAK	6-HOUR	24-HOUR	72-HOUR	Vol (A.F.)
YDROGRAPH AT	1653	611.	404.	126.	101.	250
YDROGRAPH AT	17531	129.	33.	9.	7.	
OUTED TO	1753	22.	2.	*	*	
YDROGRAPH AT	17532	129.	33.	9.	7.	
OUTED TO	1753	130.	33.	9.	7.	17
3 COMBINED	1753	611.	404.	135.	108.	268
OUTED TO	17521	548.	388.	135.	108.	
YDROGRAPH AT	1651	124.	66.	20.	16.	40
OUTED TO	17521	92.	62.	20.	16.	
2 COMBINED	17521	580.	412.	155.	124.	308
OUTED TO	1752	530.	398.	155.	124.	
YDROGRAPH AT	17521	72.	46.	16.	13.	
OUTED TO	1752	0.	0.	0.	0.	
YDROGRAPH AT	17522	72.	46.	16.	13.	
OUTED TO	1752	72.	46.	16.	13.	
3 COMBINED	1752	545.	411.	172.	137.	340
YDROGRAPH AT	17511	134.	70.	21.	17.	
OUTED TO	1751	21.	7.	2.	1.	
YDROGRAPH AT	17512	134.	70.	21.	17.	
OUTED TO	1751	134.	70.	21.	17.	
YDROGRAPH AT	1751	0.	0.	0.	0.	
4 COMBINED	1751	569.	425.	194.	155.	

IT.=	IT 30	ARCMS	LOCI	TAT=R	LAG	NSTHL	NPULS	STORA	RES
15	15	1	1753	-0.00	-0	-0	-0	-0.	-0.

AMSKK	X	QLOSS	CLOSS	NHGT	KPNCH	JPNCH
-0.000	-0.000	-0.0	-0.000	-0	-0	-0

NO ROUTING PERFORMED

NHR	NMIN	IFLAG	PRECIP	RFLAG	HFLAG	BASFLO	PUNCHH	CNEXT	BASEOP
-0	15	-0.	-0.	-0.	-0.	-0.	-0.	2.	-0.

LOCI	NOI	RATIO	IAVHG	NHGT	AVGUG	LNGTH	CONQ
1753	1	-0.00	-0	2	-0.	-0	-0.

0.

	PEAK	6-HOUR	24-HOUR	72-HOUR
CFS	0.	0.	0.	0.

VALUE OF OUTFLOW INTERVAL
15 15

COMBINED HYDROGRAPH
AT 1753 NO= 120 (15-MIN INTRVL)

0.	1.	2.	2.	3.	3.	4.	4.	5.	5.
5.	5.	6.	6.	7.	6.	8.	14.	34.	112.
130.	130.	130.	130.	130.	130.	0.	66.	23.	60.
10.	28.	5.	19.	1.	9.	0.	0.	1.	9.
40.	113.	226.	355.	472.	559.	613.	642.	650.	646.
632.	613.	591.	567.	542.	516.	492.	467.	444.	422.
400.	380.	360.	342.	324.	308.	292.	277.	263.	250.
237.	226.	214.	202.	191.	180.	169.	159.	149.	140.
131.	123.	114.	106.	98.	89.	81.	73.	65.	57.
49.	41.	34.	28.	21.	16.	11.	7.	5.	3.
1.	1.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

100-Yr. Flood Hydrograph @ CP 1753 Future Conditions

	PEAK	6-HOUR	24-HOUR	72-HOUR
CFS	650.	485.	178.	142.

Vol = 353 A.F.

RUNOFF SUMMARY, AVERAGE CFS

		PEAK	6-HOUR	24-HOUR	72-HOUR
HYDROGRAPH AT	1653	705.	505.	165.	132.
ROUTED TO	1753	650.	485.	165.	132.
HYDROGRAPH AT	17531	184.	46.	12.	10.
ROUTED TO	1753	23.	4.	*	*
HYDROGRAPH AT	17532	184.	46.	12.	10.
ROUTED TO	1753	130.	46.	12.	10.
3 COMBINED	1753	650.	485.	178.	142.
HYDROGRAPH AT	1753	0.	0.	0.	0.
2 COMBINED	1753	650.	485.	178.	142.

Flood Control District of Maricopa County
Linear Reservoir Sheetflow Model
August,1981

WATERSHED SUBAREA NUMBER = 206

WATERSHED AREA = 3.38 SQUARE MILES SLOPE = 0.003 LENGTH = 20064.00

MANNING'S N = 0.070

TIME OF CONCENTRATION = 3.25 HOURS @ INTENSITY OF 6.16 INCHES/HR.

DEPRESSION STORAGE IS 2.000 INCHES

PEAK DISCHARGE OF 647.38 CFS OCCURS AT 61 MINUTES

ELAPSED TIME (MINUTES)		RAINFALL INTENSITY (IN/HR)	INFLOW (CFS)	OUTFLOW (CFS)	
1	2.82	0.00	0.00	0.00	0.00
17	6.89	0.00	0.00	0.00	0.00
33	0.97	2115.79	265.73	38.79	1.86
49	0.81	1766.79	510.82	80.19	10.79
65	0.00	0.00	621.33	106.96	24.02
81	0.00	0.00	527.21	106.96	36.59
97	0.00	0.00	447.35	106.96	47.25
113	0.00	0.00	379.58	106.96	56.29
129	0.00	0.00	322.08	106.96	63.97
145	0.00	0.00	273.29	106.96	70.48
161	0.00	0.00	231.89	106.96	76.00
177	0.00	0.00	196.77	106.96	80.69
193	0.00	0.00	166.96	106.96	84.67
209	0.00	0.00	141.67	106.96	88.05
225	0.00	0.00	120.21	106.96	90.91
241	0.00	0.00	102.00	106.96	93.34
257	0.00	0.00	86.55	106.96	95.41
273	0.00	0.00	73.44	106.96	97.16
289	0.00	0.00	62.31	106.96	98.64
305	0.00	0.00	52.87	106.96	99.90
321	0.00	0.00	44.86	106.96	100.97
337	0.00	0.00	38.07	106.96	101.88
353	0.00	0.00	32.30	106.96	102.65
369	0.00	0.00	27.41	106.96	103.30
385	0.00	0.00	23.26	106.96	103.85
401	0.00	0.00	19.73	106.96	104.32
417	0.00	0.00	16.74	106.96	104.72
433	0.00	0.00	14.21	106.96	105.06
449	0.00	0.00	12.06	106.96	105.35
465	0.00	0.00	10.23	106.96	105.59
481	0.00	0.00	8.68	106.96	105.80
497	0.00	0.00	7.37	106.96	105.97

ARNOLD GRAPHICS

Flood Control District of Maricopa County
Linear Reservoir Sheetflow Model
August,1981

WATERSHED SUBAREA NUMBER = 206

WATERSHED AREA = 3.38 SQUARE MILES SLOPE = 0.003 LENGTH = 20064.00

MANNING'S N = 0.070

TIME OF CONCENTRATION = 3.25 HOURS @ INTENSITY OF 6.16 INCHES/HR.

DEPRESSION STORAGE IS 0.000 INCHES

PEAK DISCHARGE OF 2456.72 CFS OCCURS AT 31 MINUTES

ELAPSED TIME (MINUTES)		RAINFALL INTENSITY (IN/HR)	INFLOW (CFS)	OUTFLOW (CFS)	
1	2.82	6151.06	0.00	8.47	0.00
15	8.14	17755.20	1412.90	216.47	11.41
29	1.72	3751.71	2438.38	385.41	53.12
43	0.81	1766.79	2401.98	426.12	100.05
57	0.81	1766.79	2316.94	460.19	145.47
71	0.00	0.00	2062.76	467.49	187.92
85	0.00	0.00	1786.60	467.49	224.78
99	0.00	0.00	1547.41	467.49	256.71
113	0.00	0.00	1340.25	467.49	284.36
127	0.00	0.00	1160.82	467.49	308.31
141	0.00	0.00	1005.41	467.49	329.05
155	0.00	0.00	870.81	467.49	347.02
169	0.00	0.00	754.22	467.49	362.58
183	0.00	0.00	653.25	467.49	376.06
197	0.00	0.00	565.79	467.49	387.73
211	0.00	0.00	490.05	467.49	397.84
225	0.00	0.00	424.44	467.49	406.60
239	0.00	0.00	367.62	467.49	414.19
253	0.00	0.00	318.40	467.49	420.75
267	0.00	0.00	275.77	467.49	426.44
281	0.00	0.00	238.85	467.49	431.37
295	0.00	0.00	206.88	467.49	435.64
309	0.00	0.00	179.18	467.49	439.34
323	0.00	0.00	155.19	467.49	442.54
337	0.00	0.00	134.41	467.49	445.31
351	0.00	0.00	116.42	467.49	447.71
365	0.00	0.00	100.83	467.49	449.80
379	0.00	0.00	87.33	467.49	451.60
393	0.00	0.00	75.64	467.49	453.16
407	0.00	0.00	65.51	467.49	454.51
421	0.00	0.00	56.74	467.49	455.68
435	0.00	0.00	49.15	467.49	456.69
449	0.00	0.00	42.57	467.49	457.57
463	0.00	0.00	36.87	467.49	458.33
477	0.00	0.00	31.93	467.49	458.99
491	0.00	0.00	27.66	467.49	459.56
505	0.00	0.00	23.95	467.49	460.06
519	0.00	0.00	20.75	467.49	460.49
533	0.00	0.00	17.97	467.49	460.86
547	0.00	0.00	15.56	467.49	461.18
561	0.00	0.00	13.48	467.49	461.45
575	0.00	0.00	11.68	467.49	461.70
589	0.00	0.00	10.11	467.49	461.90
603	0.00	0.00	8.76	467.49	462.08
617	0.00	0.00	7.59	467.49	462.24
631	0.00	0.00	6.57	467.49	462.38
645	0.00	0.00	5.69	467.49	462.49
659	0.00	0.00	4.93	467.49	462.60
673	0.00	0.00	4.27	467.49	462.68
687	0.00	0.00	3.70	467.49	462.76
701	0.00	0.00	3.20	467.49	462.83

ARNOLD GRAPHICS

Flood Control District of Maricopa County
Linear Reservoir Sheetflow Model
August,1981

WATERSHED SUBAREA NUMBER = 213

WATERSHED AREA = 3.70 SQUARE MILES SLOPE = 0.003 LENGTH = 17635.00

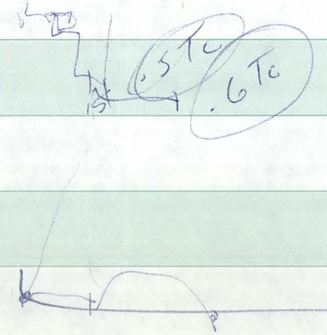
MANNING'S N = 0.070

TIME OF CONCENTRATION = 2.98 HOURS @ INTENSITY OF 6.16 INCHES/HR.

DEPRESSION STORAGE IS 0.000 INCHES

PEAK DISCHARGE OF 2890.60 CFS OCCURS AT 31 MINUTES

ELAPSED TIME (MINUTES)		RAINFALL INTENSITY (IN/HR)	INFLOW (CFS)	OUTFLOW (CFS)	
1	2.82	6733.41	0.00	9.27	0.00
15	8.14	19436.20	1678.65	236.96	13.57
29	1.72	4106.90	2873.25	421.90	62.91
43	0.81	1934.06	2800.25	466.46	117.90
57	0.81	1934.06	2674.59	503.76	170.57
71	0.00	0.00	2352.68	511.75	219.28
85	0.00	0.00	2011.37	511.75	261.04
99	0.00	0.00	1719.57	511.75	296.74
113	0.00	0.00	1470.11	511.75	327.26
127	0.00	0.00	1256.83	511.75	353.35
141	0.00	0.00	1074.50	511.75	375.66
155	0.00	0.00	918.62	511.75	394.73
169	0.00	0.00	785.35	511.75	411.03
183	0.00	0.00	671.41	511.75	424.97
197	0.00	0.00	574.01	511.75	436.89
211	0.00	0.00	490.74	511.75	447.08
225	0.00	0.00	419.54	511.75	455.79
239	0.00	0.00	358.68	511.75	463.23
253	0.00	0.00	306.64	511.75	469.60
267	0.00	0.00	262.16	511.75	475.04
281	0.00	0.00	224.12	511.75	479.70
295	0.00	0.00	191.61	511.75	483.67
309	0.00	0.00	163.81	511.75	487.07
323	0.00	0.00	140.05	511.75	489.98
337	0.00	0.00	119.73	511.75	492.47
351	0.00	0.00	102.36	511.75	494.59
365	0.00	0.00	87.51	511.75	496.41
379	0.00	0.00	74.82	511.75	497.96
393	0.00	0.00	63.96	511.75	499.29
407	0.00	0.00	54.68	511.75	500.43
421	0.00	0.00	46.75	511.75	501.40
435	0.00	0.00	39.97	511.75	502.23
449	0.00	0.00	34.17	511.75	502.94
463	0.00	0.00	29.21	511.75	503.54
477	0.00	0.00	24.97	511.75	504.06
491	0.00	0.00	21.35	511.75	504.50
505	0.00	0.00	18.25	511.75	504.88
519	0.00	0.00	15.61	511.75	505.21
533	0.00	0.00	13.34	511.75	505.48
547	0.00	0.00	11.41	511.75	505.72
561	0.00	0.00	9.75	511.75	505.92
575	0.00	0.00	8.34	511.75	506.10
589	0.00	0.00	7.13	511.75	506.24
603	0.00	0.00	6.09	511.75	506.37
617	0.00	0.00	5.21	511.75	506.48
631	0.00	0.00	4.45	511.75	506.57
645	0.00	0.00	3.81	511.75	506.65



Flood Control District of Maricopa County
Linear Reservoir Sheetflow Model
August,1981

WATERSHED SUBAREA NUMBER = 201

WATERSHED AREA = 2.89 SQUARE MILES SLOPE = 0.002 LENGTH = 18004.00

MANNING'S N = 0.070

TIME OF CONCENTRATION = 3.36 HOURS @ INTENSITY OF 6.16 INCHES/HR.

DEPRESSION STORAGE IS 2.000 INCHES

PEAK DISCHARGE OF 538.44 CFS OCCURS AT 61 MINUTES

TIME	INTENSITY	INFLOW(CFS)	OUTFLOW(CFS)	INFLOW(AC-FT)	OUTFLOW(AC-FT)
1	2.82	0.00	0.00	0.00	0.00
15	8.14	0.00	0.00	0.00	0.00
29	1.72	3207.82	134.35	21.27	0.50
43	0.81	1510.66	357.24	56.08	5.69
57	0.81	1510.66	506.83	85.21	14.16
71	0.00	0.00	487.58	91.45	24.10
85	0.00	0.00	424.34	91.45	32.84
99	0.00	0.00	369.30	91.45	40.44
113	0.00	0.00	321.40	91.45	47.06
127	0.00	0.00	279.72	91.45	52.81
141	0.00	0.00	243.44	91.45	57.83
155	0.00	0.00	211.87	91.45	62.19
169	0.00	0.00	184.39	91.45	65.98
183	0.00	0.00	160.47	91.45	69.29
197	0.00	0.00	139.66	91.45	72.16
211	0.00	0.00	121.55	91.45	74.66
225	0.00	0.00	105.78	91.45	76.84
239	0.00	0.00	92.06	91.45	78.74
253	0.00	0.00	80.12	91.45	80.39
267	0.00	0.00	69.73	91.45	81.82
281	0.00	0.00	60.69	91.45	83.07
295	0.00	0.00	52.82	91.45	84.16
309	0.00	0.00	45.97	91.45	85.10
323	0.00	0.00	40.00	91.45	85.93
337	0.00	0.00	34.82	91.45	86.64
351	0.00	0.00	30.30	91.45	87.27
365	0.00	0.00	26.37	91.45	87.81
379	0.00	0.00	22.95	91.45	88.28
393	0.00	0.00	19.97	91.45	88.69
407	0.00	0.00	17.38	91.45	89.05
421	0.00	0.00	15.13	91.45	89.36
435	0.00	0.00	13.17	91.45	89.63
449	0.00	0.00	11.46	91.45	89.87
463	0.00	0.00	9.97	91.45	90.07
477	0.00	0.00	8.68	91.45	90.25
491	0.00	0.00	7.55	91.45	90.41
505	0.00	0.00	6.57	91.45	90.54

Flood Control District of Maricopa County
Linear Reservoir Sheetflow Model
August,1981

WATERSHED SUBAREA NUMBER = 201

WATERSHED AREA = 2.89 SQUARE MILES SLOPE = 0.0023 LENGTH = 18004.00

MANNING'S N = 0.070

TIME OF CONCENTRATION = 3.36 HOURS @ INTENSITY OF 6.16 INCHES/HR.

DEPRESSION STORAGE IS 2.000 INCHES

AVERAGE CONSTANT LOSS RATE IS 0.40 INCHES PER HOUR.

PEAK DISCHARGE OF 186.64 CFS OCCURS AT 61 MINUTES

TIME	INTENSITY	INFLOW(CFS)	OUTFLOW(CFS)	INFLOW(AC-FT)	OUTFLOW(AC-FT)
1	2.42	0.00	0.00	0.00	0.00
15	7.74	0.00	0.00	0.00	0.00
29	1.32	0.00	0.00	0.00	0.00
43	0.41	764.66	78.12	11.89	0.58
57	0.41	764.66	167.16	26.64	3.02
71	0.00	0.00	169.01	29.80	6.45
85	0.00	0.00	147.09	29.80	9.48
99	0.00	0.00	128.01	29.80	12.12
113	0.00	0.00	111.41	29.80	14.41
127	0.00	0.00	96.96	29.80	16.41
141	0.00	0.00	84.38	29.80	18.14
155	0.00	0.00	73.44	29.80	19.66
169	0.00	0.00	63.91	29.80	20.97
183	0.00	0.00	55.62	29.80	22.12
197	0.00	0.00	48.41	29.80	23.11
211	0.00	0.00	42.13	29.80	23.98
225	0.00	0.00	36.67	29.80	24.73
239	0.00	0.00	31.91	29.80	25.39
253	0.00	0.00	27.77	29.80	25.96
267	0.00	0.00	24.17	29.80	26.46
281	0.00	0.00	21.04	29.80	26.89
295	0.00	0.00	18.31	29.80	27.27
309	0.00	0.00	15.93	29.80	27.60
323	0.00	0.00	13.87	29.80	27.88
337	0.00	0.00	12.07	29.80	28.13
351	0.00	0.00	10.50	29.80	28.35
365	0.00	0.00	9.14	29.80	28.54
379	0.00	0.00	7.96	29.80	28.70
393	0.00	0.00	6.92	29.80	28.84
407	0.00	0.00	6.03	29.80	28.97
421	0.00	0.00	5.24	29.80	29.08
435	0.00	0.00	4.56	29.80	29.17
449	0.00	0.00	3.97	29.80	29.25
463	0.00	0.00	3.46	29.80	29.32
477	0.00	0.00	3.01	29.80	29.38
491	0.00	0.00	2.62	29.80	29.44
505	0.00	0.00	2.28	29.80	29.48
519	0.00	0.00	1.98	29.80	29.53

Flood Control District of Maricopa County
Linear Reservoir Sheetflow Model
August,1981

WATERSHED SUBAREA NUMBER = 999

WATERSHED AREA = 1.56 SQUARE MILES SLOPE = 0.003 LENGTH = 17213.00

MANNING'S N = 0.070

TIME OF CONCENTRATION = 2.93 HOURS @ INTENSITY OF 6.16 INCHES/HR.

DEPRESSION STORAGE IS 0.000 INCHES

PEAK DISCHARGE OF 1233.43 CFS OCCURS AT 31 MINUTES

ELAPSED TIME (MINUTES)		RAINFALL INTENSITY (IN/HR)	INFLOW (CFS)	OUTFLOW (CFS)	
1	2.82	2838.95	0.00	3.91	0.00
2	2.82	2838.95	32.07	7.82	0.04
3	2.82	2838.95	63.77	11.73	0.13
4	2.82	2838.95	95.12	15.64	0.26
5	2.82	2838.95	126.11	19.55	0.44
6	3.45	3473.18	160.34	24.34	0.66
7	3.45	3473.18	197.76	29.12	0.93
8	3.45	3473.18	234.75	33.90	1.25
9	3.45	3473.18	271.33	38.69	1.63
10	3.45	3473.18	307.50	43.47	2.05
11	8.14	8194.70	369.92	54.76	2.56
12	8.14	8194.70	458.31	66.05	3.19
13	8.14	8194.70	545.69	77.33	3.94
14	8.14	8194.70	632.09	88.62	4.81
15	8.14	8194.70	717.51	99.91	5.80
16	6.89	6936.30	794.86	109.46	6.90
17	6.89	6936.30	864.23	119.02	8.09
18	6.89	6936.30	932.82	128.57	9.37
19	6.89	6936.30	1000.63	138.13	10.75
20	6.89	6936.30	1067.68	147.68	12.22
21	2.98	3000.03	1111.73	151.81	13.75
22	2.98	3000.03	1133.06	155.94	15.31
23	2.98	3000.03	1154.15	160.08	16.90
24	2.98	3000.03	1175.00	164.21	18.52
25	2.98	3000.03	1195.61	168.34	20.17
26	1.72	1731.56	1208.83	170.73	21.83
27	1.72	1731.56	1214.74	173.11	23.51
28	1.72	1731.56	1220.57	175.50	25.19
29	1.72	1731.56	1226.35	177.88	26.88
30	1.72	1731.56	1232.05	180.27	28.57
31	0.97	976.52	1233.43	181.61	30.27
32	0.97	976.52	1230.53	182.96	31.97
33	0.97	976.52	1227.66	184.30	33.66
34	0.97	976.52	1224.82	185.65	35.35
35	0.97	976.52	1222.02	186.99	37.03
36	0.85	855.71	1218.56	188.17	38.71
37	0.85	855.71	1214.46	189.35	40.38
38	0.85	855.71	1210.41	190.53	42.05
39	0.85	855.71	1206.41	191.71	43.71
40	0.85	855.71	1202.44	192.89	45.37
41	0.85	855.71	1198.53	194.06	47.02
42	0.85	855.71	1194.66	195.24	48.66
43	0.85	855.71	1190.83	196.42	50.30
44	0.85	855.71	1187.04	197.60	51.94
45	0.85	855.71	1183.30	198.78	53.57
46	0.85	855.71	1179.60	199.96	55.19
47	0.85	855.71	1175.94	201.14	56.81

ARNOLD GRAPHICS

Flood Control District of Maricopa County
Linear Reservoir Sheetflow Model
August,1981

WATERSHED SUBAREA NUMBER = 204

WATERSHED AREA = 2.55 SQUARE MILES SLOPE = 0.003 LENGTH = 17424.00

MANNING'S N = 0.070

TIME OF CONCENTRATION = 3.01 HOURS @ INTENSITY OF 6.16 INCHES/HR.

DEPRESSION STORAGE IS 0.000 INCHES

PEAK DISCHARGE OF 1973.26 CFS OCCURS AT 31 MINUTES

ELAPSED TIME (MINUTES)		RAINFALL INTENSITY (IN/HR)	INFLOW (CFS)	OUTFLOW (CFS)	
1	2.82	4640.59	0.00	6.39	0.00
16	6.89	11338.20	1267.91	178.93	11.00
31	0.97	1596.23	1973.26	296.87	48.34
46	0.81	1332.94	1895.04	326.99	88.33
61	0.00	0.00	1801.73	352.69	126.50
76	0.00	0.00	1526.13	352.69	160.61
91	0.00	0.00	1292.69	352.69	189.50
106	0.00	0.00	1094.96	352.69	213.98
121	0.00	0.00	927.47	352.69	234.71
136	0.00	0.00	785.60	352.69	252.26
151	0.00	0.00	665.43	352.69	267.14
166	0.00	0.00	563.65	352.69	279.73
181	0.00	0.00	477.43	352.69	290.41
196	0.00	0.00	404.40	352.69	299.45
211	0.00	0.00	342.54	352.69	307.10
226	0.00	0.00	290.15	352.69	313.59
241	0.00	0.00	245.77	352.69	319.08
256	0.00	0.00	208.17	352.69	323.73
271	0.00	0.00	176.33	352.69	327.67
286	0.00	0.00	149.36	352.69	331.01
301	0.00	0.00	126.51	352.69	333.84
316	0.00	0.00	107.16	352.69	336.24
331	0.00	0.00	90.77	352.69	338.26
346	0.00	0.00	76.88	352.69	339.98
361	0.00	0.00	65.12	352.69	341.44
376	0.00	0.00	55.16	352.69	342.67
391	0.00	0.00	46.72	352.69	343.72
406	0.00	0.00	39.58	352.69	344.60
421	0.00	0.00	33.52	352.69	345.35
436	0.00	0.00	28.40	352.69	345.98
451	0.00	0.00	24.05	352.69	346.52
466	0.00	0.00	20.37	352.69	346.98
481	0.00	0.00	17.26	352.69	347.36
496	0.00	0.00	14.62	352.69	347.69
511	0.00	0.00	12.38	352.69	347.97
526	0.00	0.00	10.49	352.69	348.20
541	0.00	0.00	8.88	352.69	348.40
556	0.00	0.00	7.52	352.69	348.57
571	0.00	0.00	6.37	352.69	348.71
586	0.00	0.00	5.40	352.69	348.83
601	0.00	0.00	4.57	352.69	348.93
616	0.00	0.00	3.87	352.69	349.02
631	0.00	0.00	3.28	352.69	349.09
646	0.00	0.00	2.78	352.69	349.15
661	0.00	0.00	2.35	352.69	349.21

ARNOLD GRAPHICS

Flood Control District of Maricopa County
Linear Reservoir Sheetflow Model
August,1981

WATERSHED SUBAREA NUMBER = 203

WATERSHED AREA = 3.30 SQUARE MILES SLOPE = 0.003 LENGTH = 23390.00

MANNING'S N = 0.070

TIME OF CONCENTRATION = 3.59 HOURS @ INTENSITY OF 6.16 INCHES/HR.

DEPRESSION STORAGE IS 0.000 INCHES

PEAK DISCHARGE OF 2200.77 CFS OCCURS AT 31 MINUTES

ELAPSED TIME (MINUTES)		RAINFALL INTENSITY (IN/HR)	INFLOW (CFS)	OUTFLOW (CFS)	
1	2.82	6005.47	0.00	8.27	0.00
18	6.89	14672.90	1632.97	271.98	16.35
35	0.97	2065.71	2195.85	395.56	65.41
52	0.81	1724.98	2137.20	437.42	116.17
69	0.00	0.00	1946.31	456.43	164.59
86	0.00	0.00	1662.40	456.43	206.55
103	0.00	0.00	1419.90	456.43	242.40
120	0.00	0.00	1212.78	456.43	273.02
137	0.00	0.00	1035.87	456.43	299.17
154	0.00	0.00	884.76	456.43	321.51
171	0.00	0.00	755.70	456.43	340.58
188	0.00	0.00	645.46	456.43	356.88
205	0.00	0.00	551.31	456.43	370.80
222	0.00	0.00	470.89	456.43	382.68
239	0.00	0.00	402.20	456.43	392.84
256	0.00	0.00	343.53	456.43	401.51
273	0.00	0.00	293.42	456.43	408.92
290	0.00	0.00	250.62	456.43	415.24
307	0.00	0.00	214.06	456.43	420.65
324	0.00	0.00	182.83	456.43	425.26
341	0.00	0.00	156.16	456.43	429.21
358	0.00	0.00	133.38	456.43	432.58
375	0.00	0.00	113.93	456.43	435.45
392	0.00	0.00	97.31	456.43	437.91
409	0.00	0.00	83.11	456.43	440.01
426	0.00	0.00	70.99	456.43	441.80
443	0.00	0.00	60.63	456.43	443.33
460	0.00	0.00	51.79	456.43	444.64
477	0.00	0.00	44.23	456.43	445.75
494	0.00	0.00	37.78	456.43	446.71
511	0.00	0.00	32.27	456.43	447.52
528	0.00	0.00	27.56	456.43	448.22
545	0.00	0.00	23.54	456.43	448.81
562	0.00	0.00	20.11	456.43	449.32
579	0.00	0.00	17.17	456.43	449.75
596	0.00	0.00	14.67	456.43	450.12
613	0.00	0.00	12.53	456.43	450.44
630	0.00	0.00	10.70	456.43	450.71
647	0.00	0.00	9.14	456.43	450.94
664	0.00	0.00	7.81	456.43	451.14
681	0.00	0.00	6.67	456.43	451.31
698	0.00	0.00	5.70	456.43	451.45
715	0.00	0.00	4.86	456.43	451.57
732	0.00	0.00	4.16	456.43	451.68
749	0.00	0.00	3.55	456.43	451.77
766	0.00	0.00	3.03	456.43	451.84
783	0.00	0.00	2.59	456.43	451.91

ARNOLD GRAPHICS

Flood Control District of Maricopa County
Linear Reservoir Sheetflow Model
August,1981

WATERSHED SUBAREA NUMBER = 203

WATERSHED AREA = 3.30 SQUARE MILES SLOPE = 0.003 LENGTH = 23390.00

MANNING'S N = 0.070

TIME OF CONCENTRATION = 3.59 HOURS @ INTENSITY OF 6.16 INCHES/HR.

DEPRESSION STORAGE IS 2.000 INCHES

PEAK DISCHARGE OF 582.30 CFS OCCURS AT 61 MINUTES

ELAPSED TIME (MINUTES)	RAINFALL INTENSITY (IN/HR)	INFLOW (CFS)	OUTFLOW (CFS)	
1	2.82	0.00	0.00	0.00
18	6.89	0.00	0.00	0.00
35	0.97	2065.71	269.07	43.56	2.36
52	0.81	1724.98	491.47	85.42	11.58
69	0.00	0.00	540.66	104.43	24.51
86	0.00	0.00	461.79	104.43	36.17
103	0.00	0.00	394.43	104.43	46.12
120	0.00	0.00	336.89	104.43	54.63
137	0.00	0.00	287.75	104.43	61.89
154	0.00	0.00	245.77	104.43	68.10
171	0.00	0.00	209.92	104.43	73.40
188	0.00	0.00	179.30	104.43	77.92
205	0.00	0.00	153.14	104.43	81.79
222	0.00	0.00	130.81	104.43	85.09
239	0.00	0.00	111.72	104.43	87.91
256	0.00	0.00	95.43	104.43	90.32
273	0.00	0.00	81.51	104.43	92.38
290	0.00	0.00	69.62	104.43	94.14
307	0.00	0.00	59.46	104.43	95.64
324	0.00	0.00	50.79	104.43	96.92
341	0.00	0.00	43.38	104.43	98.01
358	0.00	0.00	37.05	104.43	98.95
375	0.00	0.00	31.65	104.43	99.75
392	0.00	0.00	27.03	104.43	100.43
409	0.00	0.00	23.09	104.43	101.01
426	0.00	0.00	19.72	104.43	101.51
443	0.00	0.00	16.84	104.43	101.94
460	0.00	0.00	14.39	104.43	102.30
477	0.00	0.00	12.29	104.43	102.61
494	0.00	0.00	10.50	104.43	102.88
511	0.00	0.00	8.96	104.43	103.10
528	0.00	0.00	7.66	104.43	103.30
545	0.00	0.00	6.54	104.43	103.46

ARNOLD GRAPHICS

Flood Control District of Maricopa County
Linear Reservoir Sheetflow Model
August,1981

WATERSHED SUBAREA NUMBER = 202

WATERSHED AREA = 3.20 SQUARE MILES SLOPE = 0.002 LENGTH = 22018.00

MANNING'S N = 0.070

TIME OF CONCENTRATION = 3.70 HOURS @ INTENSITY OF 6.16 INCHES/HR.

DEPRESSION STORAGE IS 2.000 INCHES

PEAK DISCHARGE OF 551.73 CFS OCCURS AT 61 MINUTES

ELAPSED TIME (MINUTES)	RAINFALL INTENSITY (IN/HR)	INFLOW (CFS)	OUTFLOW (CFS)	
1	2.82	0.00	0.00	0.00
16	6.89	0.00	0.00	0.00
31	0.97	2003.11	189.78	31.20	0.96
46	0.81	1672.70	397.99	69.01	7.33
61	0.00	0.00	551.73	101.26	17.36
76	0.00	0.00	481.94	101.26	27.97
91	0.00	0.00	420.97	101.26	37.24
106	0.00	0.00	367.72	101.26	45.34
121	0.00	0.00	321.20	101.26	52.41
136	0.00	0.00	280.57	101.26	58.59
151	0.00	0.00	245.08	101.26	63.99
166	0.00	0.00	214.08	101.26	68.71
181	0.00	0.00	187.00	101.26	72.82
196	0.00	0.00	163.34	101.26	76.42
211	0.00	0.00	142.68	101.26	79.56
226	0.00	0.00	124.63	101.26	82.31
241	0.00	0.00	108.86	101.26	84.71
256	0.00	0.00	95.09	101.26	86.80
271	0.00	0.00	83.06	101.26	88.63
286	0.00	0.00	72.56	101.26	90.23
301	0.00	0.00	63.38	101.26	91.62
316	0.00	0.00	55.36	101.26	92.84
331	0.00	0.00	48.36	101.26	93.91
346	0.00	0.00	42.24	101.26	94.84
361	0.00	0.00	36.90	101.26	95.65
376	0.00	0.00	32.23	101.26	96.36
391	0.00	0.00	28.15	101.26	96.98
406	0.00	0.00	24.59	101.26	97.52
421	0.00	0.00	21.48	101.26	98.00
436	0.00	0.00	18.76	101.26	98.41
451	0.00	0.00	16.39	101.26	98.77
466	0.00	0.00	14.32	101.26	99.09
481	0.00	0.00	12.51	101.26	99.36
496	0.00	0.00	10.92	101.26	99.60
511	0.00	0.00	9.54	101.26	99.81
526	0.00	0.00	8.33	101.26	99.99
541	0.00	0.00	7.28	101.26	100.16
556	0.00	0.00	6.36	101.26	100.30

Flood Control District of Maricopa County
Linear Reservoir Sheetflow Model
August,1981

WATERSHED SUBAREA NUMBER = 207

WATERSHED AREA = 1.56 SQUARE MILES SLOPE = 0.003 LENGTH = 17213.00

MANNING'S N = 0.070

TIME OF CONCENTRATION = 2.93 HOURS @ INTENSITY OF 6.16 INCHES/HR.

DEPRESSION STORAGE IS 2.000 INCHES

PEAK DISCHARGE OF 323.60 CFS OCCURS AT 61 MINUTES

ELAPSED TIME (MINUTES)		RAINFALL INTENSITY (IN/HR)	INFLOW (CFS)	OUTFLOW (CFS)	
1	2.82	0.00	0.00	0.00	0.00
16	6.89	0.00	0.00	0.00	0.00
31	0.97	976.52	115.71	15.21	0.59
46	0.81	815.44	237.69	33.64	4.42
61	0.00	0.00	323.60	49.37	10.35
76	0.00	0.00	272.90	49.37	16.46
91	0.00	0.00	230.14	49.37	21.62
106	0.00	0.00	194.09	49.37	25.96
121	0.00	0.00	163.68	49.37	29.63
136	0.00	0.00	138.04	49.37	32.72
151	0.00	0.00	116.41	49.37	35.33
166	0.00	0.00	98.17	49.37	37.53
181	0.00	0.00	82.79	49.37	39.38
196	0.00	0.00	69.82	49.37	40.95
211	0.00	0.00	58.88	49.37	42.27
226	0.00	0.00	49.66	49.37	43.38
241	0.00	0.00	41.88	49.37	44.32
256	0.00	0.00	35.32	49.37	45.11
271	0.00	0.00	29.78	49.37	45.77
286	0.00	0.00	25.12	49.37	46.34
301	0.00	0.00	21.18	49.37	46.81
316	0.00	0.00	17.86	49.37	47.21
331	0.00	0.00	15.07	49.37	47.55
346	0.00	0.00	12.70	49.37	47.83
361	0.00	0.00	10.71	49.37	48.07
376	0.00	0.00	9.04	49.37	48.28
391	0.00	0.00	7.62	49.37	48.45
406	0.00	0.00	6.43	49.37	48.59
421	0.00	0.00	5.42	49.37	48.71
436	0.00	0.00	4.57	49.37	48.81
451	0.00	0.00	3.85	49.37	48.90

Flood Control District of Maricopa County
Linear Reservoir Sheetflow Model
August,1981

WATERSHED SUBAREA NUMBER = 202

WATERSHED AREA = 3.20 SQUARE MILES SLOPE = 0.002 LENGTH = 22018.00

MANNING'S N = 0.070

TIME OF CONCENTRATION = 3.70 HOURS @ INTENSITY OF 6.16 INCHES/HR.

DEPRESSION STORAGE IS 0.000 INCHES

PEAK DISCHARGE OF 2090.47 CFS OCCURS AT 31 MINUTES

TIME	INTENSITY	INFLOW(CFS)	OUTFLOW(CFS)	INFLOW(AC-FT)	OUTFLOW(AC-FT)
1	2.82	5823.49	0.00	8.02	0.00
15	8.14	16809.60	1182.40	204.94	9.54
29	1.72	3551.92	2070.95	366.17	44.76
43	0.81	1672.70	2068.81	404.71	84.92
57	0.81	1672.70	2021.84	436.96	124.32
71	0.00	0.00	1829.35	443.87	161.66
85	0.00	0.00	1612.41	443.87	194.65
99	0.00	0.00	1421.20	443.87	223.73
113	0.00	0.00	1252.66	443.87	249.36
127	0.00	0.00	1104.11	443.87	271.95
141	0.00	0.00	973.17	443.87	291.87
155	0.00	0.00	857.77	443.87	309.42
169	0.00	0.00	756.04	443.87	324.89
183	0.00	0.00	666.39	443.87	338.52
197	0.00	0.00	587.36	443.87	350.54
211	0.00	0.00	517.71	443.87	361.13
225	0.00	0.00	456.31	443.87	370.47
239	0.00	0.00	402.20	443.87	378.70
253	0.00	0.00	354.50	443.87	385.95
267	0.00	0.00	312.46	443.87	392.35
281	0.00	0.00	275.41	443.87	397.98
295	0.00	0.00	242.75	443.87	402.95
309	0.00	0.00	213.96	443.87	407.33
323	0.00	0.00	188.59	443.87	411.18
337	0.00	0.00	166.22	443.87	414.58
351	0.00	0.00	146.51	443.87	417.58
365	0.00	0.00	129.14	443.87	420.23
379	0.00	0.00	113.82	443.87	422.55
393	0.00	0.00	100.32	443.87	424.61
407	0.00	0.00	88.43	443.87	426.42
421	0.00	0.00	77.94	443.87	428.01
435	0.00	0.00	68.70	443.87	429.42
449	0.00	0.00	60.55	443.87	430.66
463	0.00	0.00	53.37	443.87	431.75
477	0.00	0.00	47.04	443.87	432.71
491	0.00	0.00	41.46	443.87	433.56
505	0.00	0.00	36.55	443.87	434.31
519	0.00	0.00	32.21	443.87	434.97
533	0.00	0.00	28.39	443.87	435.55
547	0.00	0.00	25.02	443.87	436.06
561	0.00	0.00	22.06	443.87	436.51
575	0.00	0.00	19.44	443.87	436.91
589	0.00	0.00	17.14	443.87	437.26
603	0.00	0.00	15.10	443.87	437.57
617	0.00	0.00	13.31	443.87	437.84
631	0.00	0.00	11.73	443.87	438.08
645	0.00	0.00	10.34	443.87	438.29
659	0.00	0.00	9.12	443.87	438.48
673	0.00	0.00	8.03	443.87	438.64
687	0.00	0.00	7.08	443.87	438.79
701	0.00	0.00	6.24	443.87	438.92
715	0.00	0.00	5.50	443.87	439.03
729	0.00	0.00	4.85	443.87	439.13
743	0.00	0.00	4.27	443.87	439.22
757	0.00	0.00	3.77	443.87	439.29
771	0.00	0.00	3.32	443.87	439.36
785	0.00	0.00	2.93	443.87	439.42
799	0.00	0.00	2.58	443.87	439.47

Flood Control District of Maricopa County
Linear Reservoir Sheetflow Model
August,1981

WATERSHED SUBAREA NUMBER = 211

WATERSHED AREA = 3.32 SQUARE MILES SLOPE = 0.002 LENGTH = 17424.00

MANNING'S N = 0.060

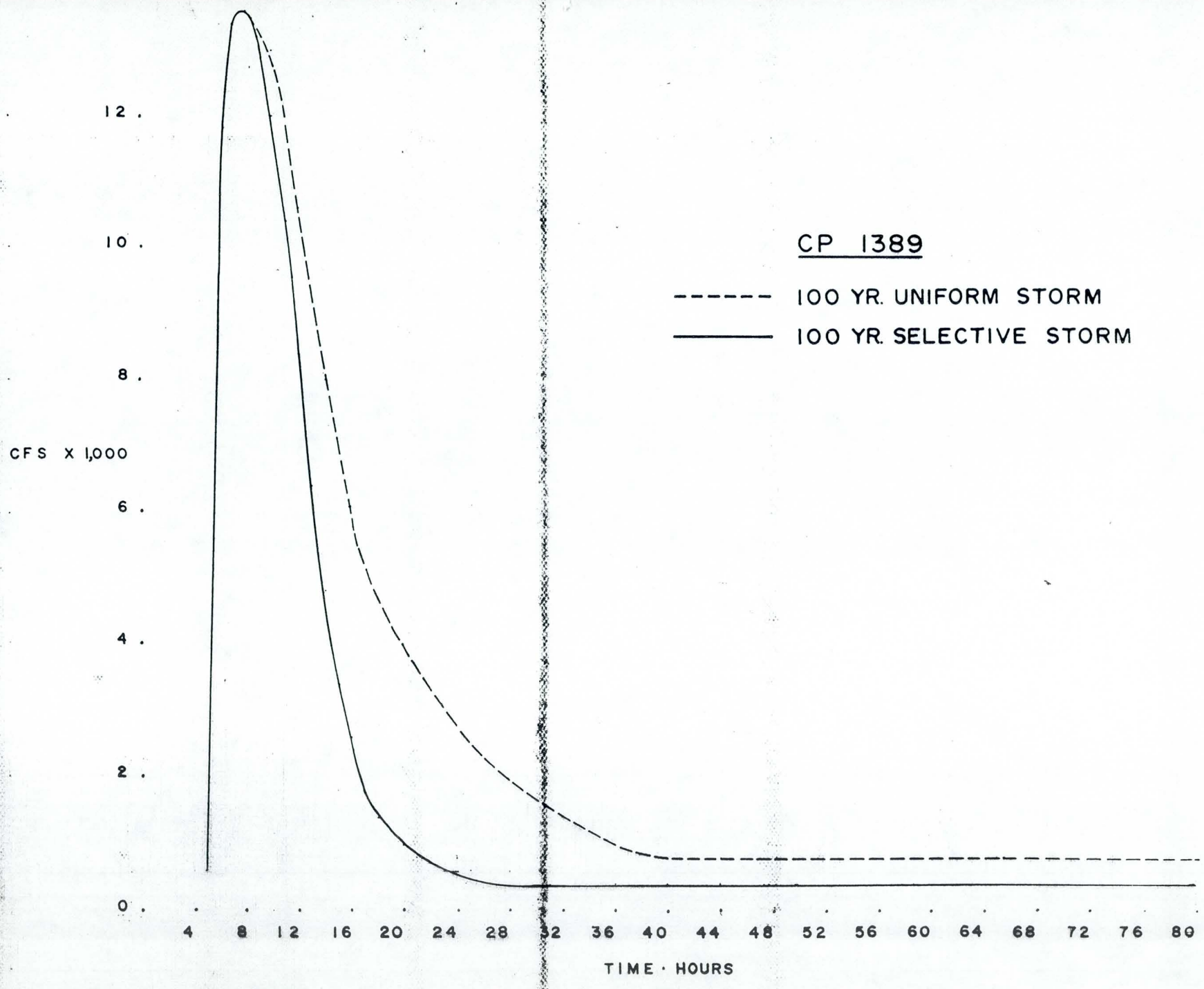
TIME OF CONCENTRATION = 3.04 HOURS @ INTENSITY OF 6.16 INCHES/HR.

DEPRESSION STORAGE IS 1.000 INCHES

PEAK DISCHARGE OF 1560.22 CFS OCCURS AT 60 MINUTES

TIME	INTENSITY	INFLOW(CFS)	OUTFLOW(CFS)	INFLOW(AC-FT)	OUTFLOW(AC-FT)
1	2.82	0.00	0.00	0.00	0.00
15	8.14	17440.00	185.75	35.56	0.32
29	1.72	3685.11	1424.49	201.50	20.80
43	0.81	1735.43	1524.37	241.49	49.64
57	0.81	1735.43	1554.37	274.95	79.36
71	0.00	0.00	1391.60	282.13	108.08
85	0.00	0.00	1193.77	282.13	132.82
99	0.00	0.00	1024.06	282.13	154.05
113	0.00	0.00	878.47	282.13	172.26
127	0.00	0.00	753.59	282.13	187.88
141	0.00	0.00	646.45	282.13	201.27
155	0.00	0.00	554.55	282.13	212.77
169	0.00	0.00	475.72	282.13	222.63
183	0.00	0.00	408.09	282.13	231.09
197	0.00	0.00	350.07	282.13	238.34
211	0.00	0.00	300.30	282.13	244.57
225	0.00	0.00	257.61	282.13	249.91
239	0.00	0.00	220.99	282.13	254.49
253	0.00	0.00	189.57	282.13	258.42
267	0.00	0.00	162.62	282.13	261.79
281	0.00	0.00	139.50	282.13	264.68
295	0.00	0.00	119.67	282.13	267.16
309	0.00	0.00	102.66	282.13	269.29
323	0.00	0.00	88.06	282.13	271.11
337	0.00	0.00	75.54	282.13	272.68
351	0.00	0.00	64.81	282.13	274.02
365	0.00	0.00	55.59	282.13	275.17
379	0.00	0.00	47.69	282.13	276.16
393	0.00	0.00	40.91	282.13	277.01
407	0.00	0.00	35.09	282.13	277.74
421	0.00	0.00	30.10	282.13	278.36
435	0.00	0.00	25.82	282.13	278.90
449	0.00	0.00	22.15	282.13	279.36

ARNOLD GRAPHICS


CP 1389
100 YR. UNIFORM STORM
100 YR. SELECTIVE STORM
CFS X 1,000
12.
10.
8.
6.
4.
2.
0.
4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68 72 76 80
TIME · HOURS

bombs 46

line 37
line 112

```
+0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000

                    $   $  $   $  $$$$       $$$$       $  $$$$
                    $   $  $   $  $   $      $   $      $  $   $
                    $   $   $ $   $   $      $   $      $  $   $
                    $$$$$    $    $   $      $   $      $  $$$$
                    $   $    $    $   $      $   $      $  $
                    $   $    $    $   $  $$  $   $  $   $  $
                    $   $    $    $$$$   $$  $$$$    $$$   $

                  DEST=HYD.DJP  USER=HYD.DJP  QUEUE=LPT  DEVICE=@LPB
               SEQ=12457  QPRI=128  LPP=66  CPL=136  COPIES=1  LIMIT=89

                           CREATED:  10-AUG-88  13:24:50
                          ENQUEUED:  10-AUG-88  13:39:58
                          PRINTING:  10-AUG-88  13:40:02

                          PATH=:UDD:HYD.DJP:GUADALUPE.OUT

 $$$$  $   $    $    $$$$     $    $      $   $  $$$$   $$$$$       $$$   $   $  $$$$$
$      $   $   $ $   $   $   $ $   $      $   $  $   $  $          $   $  $   $    $
$      $   $  $   $  $   $  $   $  $      $   $  $   $  $          $   $  $   $    $
$      $   $  $   $  $   $  $   $  $      $   $  $$$$   $$$$       $   $  $   $    $
$  $$  $   $  $$$$$  $   $  $$$$$  $      $   $  $      $          $   $  $   $    $
$   $  $   $  $   $  $   $  $   $  $      $   $  $      $      $$  $   $  $   $    $
 $$$$   $$$   $   $  $$$$   $   $  $$$$$   $$$   $      $$$$$  $$   $$$    $$$     $
+0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000


                               AOS/VS REV 7.57.00.00


                                 AOS/VS REV 07.57
                               AOS/VS XLPT REV 07.56
```

```
**** AOS/VS REV 7.57.00.00 / BATCH OUTPUT FILE ****

AOS/VS 7.57.00.00 / EXEC-32 7.57.00.00  10-AUG-88       13:24:52
QPRI=128        SEQ=12451
INPUT FILE -- :UDD:HYD.DJP:?75.CLI.00001.JOB (WILL BE DELETED AFTER PROCESSING)
LIST FILE  -- :QUEUE:HYD.DJP.LIST.12451

--------
LAST MESSAGE CHANGE     25-OCT-86        0:36:12

```

```

--------
LAST PREVIOUS LOGON     10-AUG-88        8:20:02

AOS/VS CLI   REV 07.56.00.00    10-AUG-88       13:24:54
) SEARCHLIST :UTIL,:MACROS,:
) DIRECTORY :UDD:HYD.DJP
) DEFACL HYD.DJP,OWARE
)
)
) LISTFILE GUADALUPE.OUT
) DATAFILE GUADALUPE
) SEA :UTIL:HEC1.DIR,[!SEA]
) X HEC1_START
```

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             FEBRUARY 1981             *
*           REVISED 31 JAN 85           *
*                                       *
*  RUN DATE 8/10/1988   TIME13:24:55 *
*                                       *
*****************************************
```


```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*  THE HYDROLOGIC ENGINEERING CENTER    *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
* (916) 440-3285 OR (FTS) 448-3285   *
*                                       *
*****************************************
```


```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THE VERSION RELEASED 31JAN85
CONTAINS NEW OPTIONS ON RL AND BA RECORDS, AND ADDS THE HL RECORD. SEE JANUARY 1985 INPUT
DESCRIPTION FOR NEW DEFINITIONS.

```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
*** FREE ***
              *DIAGRAM
    1         ID    GUADALUPE DAM WATERSHED ANALYSIS
    2         ID    FCDMC  JUNE 30, 1988
    3         ID    GLEN VORTHERMS
    4         ID    RAINFALL:  CENNTENIAL WASH SEPT. 1, 1984 STORM
    5         IT       5 30JUN88    1200     150
    6         IO       5       0

    7         KK    SUB1
    8         KO       0       2
    9         BA   0.346
   10         IN      15
   11         PB    6.64
   12         PI    0.45    0.45    0.45    0.45   0.688   0.688   0.688   0.688    0.46    0.46
   13         PI    0.46    0.46   0.063   0.063   0.063   0.063
   14         LS       0      88
   15         UI     0.0    35.0   110.0   235.0   339.0   381.0   347.0   259.0   196.0   162.0
   16         UI   122.0    93.0    82.0    75.0    53.0    46.0    28.0    23.0    20.0    13.0
   17         UI    12.0    11.0    12.0     6.0     6.0     5.0     5.0     1.0     0.0

   18         KK    SUB2
   19         BA    .571
   20         LS       0      88
   21         UI     0.0    38.0    97.0   199.0   326.0   447.0   452.0   481.0   404.0   327.0
   22         UI   262.0   229.0   184.0   153.0   122.0   107.0   100.0    94.0    69.0    60.0
   23         UI    53.0    30.0    29.0    31.0    16.0    16.0    15.0    15.0    14.0    14.0
   24         UI     7.0     7.0     7.0     7.0     6.0     1.0     0.0

   25         KK    COMB1&2
   26         HC       2

   27         KK    ROUTE
   28         RK    8785    .025   0.030           TRAP      50       1

   29         KK    SUB3
   30         BA    .521
   31         LS       0      88
   32         UI     0.0    45.0   127.0   279.0   437.0   492.0   518.0   414.0   330.0   258.0
   33         UI   215.0   166.0   130.0   114.0   105.0    86.0    65.0    56.0    32.0    31.0
   34         UI    27.0    17.0    16.0    16.0    15.0    12.0     8.0     7.0     7.0     7.0
   35         UI     0.0     0.0

   36         KK    COMB(1&2) & 3
   37         HC       2

   38         KK    ROUTE
   39         RK    5020   .0149   0.30           TRAP      50       1

   40         KK    SUB4
   41         BA    .517
   42         LS       0      80
   43         UI     0.0   226.0   719.0  1221.0  1033.0   491.0   181.0    93.0    26.0    13.0
   44         UI     0.0
```

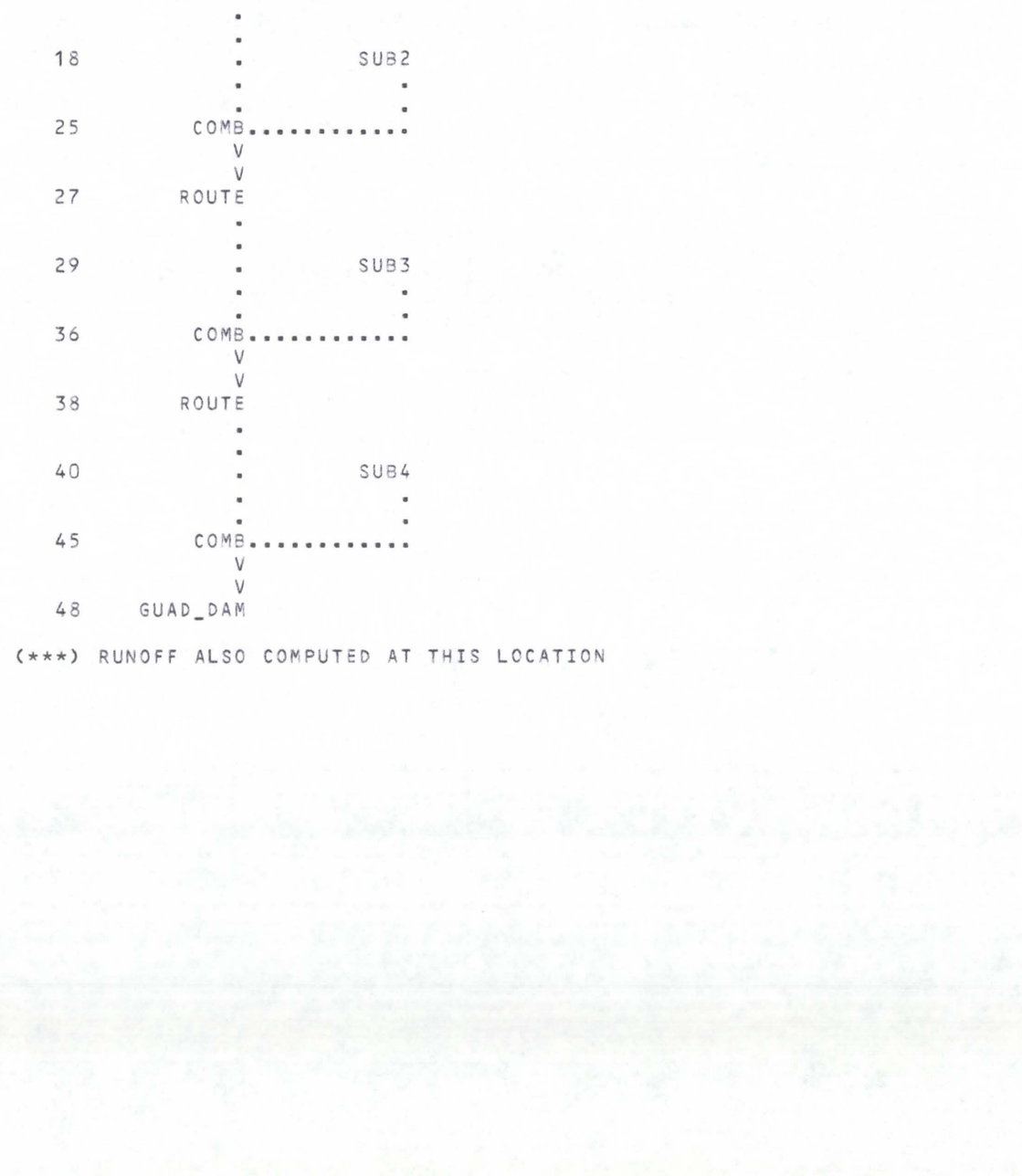
```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  45          KK     COMB(1&2&3) & 4
  46          HC       2
  47          KO       3       2

  48          KKGUAD_DAM
  49          KO       3       2
  50          RS       1    STOR       0
  51          SV       0    4.65    12.8    25.8    43.0    63.6    87.8     115     147     184
  52          SV     226     275     328     388     454     526     564
  53          SE    1250    1252    1254    1256    1258    1260    1262    1264    1266    1268
  54          SE    1270    1272    1274    1276    1278    1280    1281
  55          SQ       0      14      15      16      17      18      18      18      19     322
  56          SQ    1139    2369    3960    5870    8020   10420
  57          SE    1259    1260    1262    1264    1266    1268    1270    1272    1274    1275
  58          SE    1276    1277    1278    1279    1280    1281
  59          SS    1274       0       0       0
  60          ST    1281    2910    3.05     1.5
  61          ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT LINE NO.

(V) ROUTING
(.) CONNECTOR

(--->) DIVERSION OR PUMP FLOW
(<---) RETURN OF DIVERTED OR PUMPED FLOW



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             FEBRUARY 1981             *
*           REVISED 31 JAN 85           *
*                                       *
*  RUN DATE 8/10/1988   TIME13:25: 0 *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*  THE HYDROLOGIC ENGINEERING CENTER    *
*         609 SECOND STREET             *
*       DAVIS, CALIFORNIA 95616         *
* (916) 440-3285 OR (FTS) 448-3285   *
*                                       *
*****************************************
```

GUADALUPE DAM WATERSHED ANALYSIS
FCDMC JUNE 30, 1988
GLEN VORTHERMS
RAINFALL: CENNTENIAL WASH SEPT. 1, 1984 STORM

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

    IT          HYDROGRAPH TIME DATA
                       NMIN           5  MINUTES IN COMPUTATION INTERVAL
                      IDATE     30JUN88  STARTING DATE
                      ITIME        1200  STARTING TIME
                         NQ         150  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      1JUL88  ENDING DATE
                     NDTIME        0025  ENDING TIME

                 COMPUTATION INTERVAL      .08 HOURS
                     TOTAL TIME BASE    12.42 HOURS

          ENGLISH UNITS
               DRAINAGE AREA          SQUARE MILES
               PRECIPITATION DEPTH    INCHES
               LENGTH, ELEVATION      FEET
               FLOW                   CUBIC FEET PER SECOND
               STORAGE VOLUME         ACRE-FEET
               SURFACE AREA           ACRES
               TEMPERATURE            DEGREES FAHRENHEIT


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
  7 KK      *      SUB1  *
            *            *
            **************

  8 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           5  PRINT CONTROL
                      IPLOT           2  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
```

STATION SUB1

(O) OUTFLOW

		0.	100.	200.	300.	400.	500.	600.	0.	0.	0.	0.	0.	0.
		.0	.0	.0	.0	.0	.0	.0	.0	.0	.3	(L) PRECIP, .2	(X) EXCESS .1	.0
DAHRMN	PER													
301200	10													
301205	20												LLLLLLLLLLLLLLL	
301210	30												LLLLLLLLLLLLLLL	
301215	40												LLLLLLLLLLLLLXX	
301220	50												LLLLLLLLLLLXXXX	
301225	60												LLLLLLLLLXXXXXX	
301230	7.0												LLLLLLLLXXXXXXX	
301235	8.	O											LLLLLLLXXXXXXXX	
301240	9.		O										LLLLLLXXXXXXXXX	
301245	10.			O									LLLLLXXXXXXXXXX	
301250	11.				O								LLLLXXXXXXXXXXX	
301255	12.					O							LLLLXXXXXXXXXXX	
301300	13.						O						LLLLXXXXXXXXXXX	
301305	14.							O					LLLLLXXXXXXXXXXXXXXXXX	
301310	15.							O					LLLLXXXXXXXXXXXXXXXXX	
301315	16.								O				LLLLXXXXXXXXXXXXXXXXX	
301320	17.									O			LLLXXXXXXXXXXXXXXXXX	
301325	18.									O			LLLXXXXXXXXXXXXXXXXX	
301330	19.								O				LLLXXXXXXXXXXXXXXXXX	
301335	20.							O					LLXXXXXXXXXXXXXXXXX	
301340	21.						O						LLXXXXXXXXXXXXXXXXX	
301345	22.							O					LLXXXXXXXXXXXXXXXXX	
301350	23.								O				LLXXXXXXXXXXXXXXXXX	
301355	24.									O			LLXXXXXXXXXXXXXXXXX	
301400	25.										O		LXXXXXXXXXXXXXXXXX	
301405	26.										O		LXXXXXXXXXXXXXX	
301410	27.										O		LXXXXXXXXXXXXXX	
301415	28.										O		XXXXXXXXXXXXXXX	
301420	29.										O		XXXXXXXXXXXXXXX	
301425	30.										O		XXXXXXXXXXXXXXX	
301430	31.									O			XXXXXXXXXXXXXXX	
301435	32.									O			XXXXXXXXXXXXXXX	
301440	33.								O				XXXXXXXXXXXXXXX	
301445	34.								O				XXXXXXXXXXXXXXX	
301450	35.								O				XXXXXXXXXXXXXXX	
301455	36.							O					XXXXXXXXXXXXXXX	
301500	37.							O					XXXXXXXXXXXXXXX	
301505	38.							O					XX	
301510	39.							O					XX	
301515	40.							O					XX	
301520	41.						O						XX	
301525	42.					O							XX	
301530	43.				O								XX	
301535	44.			O									XX	
301540	45.		O										XX	
301545	46.	O											XX	
301550	47.		O										XX	
301555	48.		O										XX	
301600	49.	O											XX	
301605	50.	O												
301610	51.													
301615	52.	O												
301620	53.		O											

301625 54. 0
301630 55. 0
301635 56. 0

301640 57. 0
301645 58. 0
301650 59. 0
301655 60.0
301700 61.0
301705 62.0
301710 63.0
301715 640
301720 650
301725 660
301730 670
301735 680
301740 690
301745 700
301750 710
301755 720
301800 730
301805 740
301810 750
301815 760
301820 770
301825 780
301830 790
301835 800
301840 810
301845 820
301850 830
301855 840
301900 850
301905 860
301910 870
301915 880
301920 890
301925 900
301930 910
301935 920
301940 930
301945 940
301950 950
301955 960
302000 970
302005 980
302010 990
302015 1000
302020 1010
302025 1020
302030 1030
302035 1040
302040 1050
302045 1060
302050 1070
302055 1080
302100 1090
302105 1100
302110 1110
302115 1120
302120 1130
302125 1140
302130 1150
302135 1160

302140 1170
302145 1180
302150 1190

302155 1200
302200 1210
302205 1220
302210 1230
302215 1240
302220 1250
302225 1260
302230 1270
302235 1280
302240 1290
302245 1300
302250 1310
302255 1320
302300 1330
302305 1340
302310 1350
302315 1360
302320 1370
302325 1380
302330 1390
302335 1400
302340 1410
302345 1420
302350 1430
302355 1440
10000 1450
10005 1460
10010 1470
10015 1480
10020 1490
10025 1500

```
*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

             *************
             *           *
  45 KK      *     COMB  *     (1&2&3) & 4
             *           *
             *************

  47 KO           OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           2  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE

  46 HC           HYDROGRAPH COMBINATION
                        ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                      ***

      ***              ***              ***              ***              ***

                                HYDROGRAPH AT STATION     COMB

 PEAK FLOW      TIME                              MAXIMUM AVERAGE FLOW
   (CFS)        (HR)                      6-HR        24-HR        72-HR       12.42-HR
    2604.       2.50          (CFS)       1038.        508.         508.          508.
                            (INCHES)      4.935        5.001        5.001         5.001
                             (AC-FT)       515.         521.         521.          521.

                              CUMULATIVE AREA =     1.95 SQ MI
```

STATION COMB

(O) OUTFLOW

DAHRMN	PER	0.	400.	800.	1200.	1600.	2000.	2400.	2800.	0.	0.	0.	0.	0.
301200	10													
301205	20													
301210	30													
301215	40													
301220	50													
301225	60													
301230	70													
301235	8.0													
301240	9.	O												
301245	10.		O											
301250	11.			O										
301255	12.				O									
301300	13.					O								
301305	14.						O							
301310	15.							O						
301315	16.								O					
301320	17.									O				
301325	18.										O			
301330	19.											O		
301335	20.												O	
301340	21.									O				
301345	22.										O			
301350	23.											O		
301355	24.												O	
301400	25.													O
301405	26.													O
301410	27.													O
301415	28.													O
301420	29.													O
301425	30.													O
301430	31.													O
301435	32.													O
301440	33.													O
301445	34.													O
301450	35.													O
301455	36.													O
301500	37.													O
301505	38.													O
301510	39.													O
301515	40.													O
301520	41.													O
301525	42.													O
301530	43.													O
301535	44.													O
301540	45.													O
301545	46.													O
301550	47.													O
301555	48.													O
301600	49.													O
301605	50.													O
301610	51.													O
301615	52.													O
301620	53.													O
301625	54.													O
301630	55.													O

301635	56.
301640	57.
301645	58.
301650	59.
301655	60.
301700	61.
301705	62.
301710	63.
301715	64.
301720	65.
301725	66.
301730	67.
301735	68.
301740	69.
301745	70.
301750	71.
301755	72.
301800	73.
301805	74.
301810	75.
301815	76.
301820	77.
301825	78.
301830	79.
301835	80.
301840	81.
301845	82.
301850	83.
301855	84.
301900	85.
301905	86.
301910	87.
301915	88.
301920	89.
301925	90.
301930	91.
301935	92.
301940	93.
301945	94.
301950	95.
301955	96.
302000	970
302005	980
302010	990
302015	1000
302020	1010
302025	1020
302030	1030
302035	1040
302040	1050
302045	1060
302050	1070
302055	1080
302100	1090
302105	1100
302110	1110
302115	1120
302120	1130
302125	1140
302130	1150
302135	1160
302140	1170
302145	1180

302150 1190
302155 1200
302200 1210

302205 1220
302210 1230
302215 1240
302220 1250
302225 1260
302230 1270
302235 1280
302240 1290
302245 1300
302250 1310
302255 1320
302300 1330
302305 1340
302310 1350
302315 1360
302320 1370
302325 1380
302330 1390
302335 1400
302340 1410
302345 1420
302350 1430
302355 1440
10000 1450
10005 1460
10010 1470
10015 1480
10020 1490
10025 1500

*** ***

```
          **************
          *            *
48 KK     *  GUAD_DAM  *
          *            *
          **************

49 KO          OUTPUT CONTROL VARIABLES
                    IPRNT           3  PRINT CONTROL
                    IPLOT           2  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE

               HYDROGRAPH ROUTING DATA

50 RS          STORAGE ROUTING
                    NSTPS           1  NUMBER OF SUBREACHES
                     ITYP        STOR  TYPE OF INITIAL CONDITION
                   RSVRIC         .00  INITIAL CONDITION
                        X         .00  WORKING R AND D COEFFICIENT

51 SV            STORAGE          .0       4.6      12.8      25.8      43.0      63.6      87.8     115.0     147.0     184.0
                                226.0     275.0     328.0     388.0     454.0     526.0     564.0

53 SE          ELEVATION      1250.00   1252.00   1254.00   1256.00   1258.00   1260.00   1262.00   1264.00   1266.00   1268.00
                              1270.00   1272.00   1274.00   1276.00   1278.00   1280.00   1281.00

55 SQ          DISCHARGE          0.       14.       15.       16.       17.       18.       18.       18.       19.      322.
                                1139.     2369.     3960.     5870.     8020.    10420.

57 SE          ELEVATION      1259.00   1260.00   1262.00   1264.00   1266.00   1268.00   1270.00   1272.00   1274.00   1275.00
                              1276.00   1277.00   1278.00   1279.00   1280.00   1281.00

59 SS          SPILLWAY
                    CREL      1274.00  SPILLWAY CREST ELEVATION
                   SPWID          .00  SPILLWAY WIDTH
                    COQW          .00  WEIR COEFFICIENT
                    EXPW         1.50  EXPONENT OF HEAD

60 ST          TOP OF DAM
                   TOPEL      1281.00  ELEVATION AT TOP OF DAM
                  DAMWID      2910.00  DAM WIDTH
                    COQD         3.05  WEIR COEFFICIENT
                    EXPD         1.50  EXPONENT OF HEAD
```

***

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	4.65	12.80	25.80	43.00	53.30	63.60	87.80	115.00	147.00
OUTFLOW	.00	.00	.00	.00	.00	.00	14.00	15.00	16.00	17.00
ELEVATION	1250.00	1252.00	1254.00	1256.00	1258.00	1259.00	1260.00	1262.00	1264.00	1266.00

STORAGE	184.00	226.00	275.00	328.00	358.00	388.00	421.00	454.00	490.00	526.00
OUTFLOW	18.00	18.00	18.00	19.00	322.00	1139.00	2369.00	3960.00	5870.00	8020.00
ELEVATION	1268.00	1270.00	1272.00	1274.00	1275.00	1276.00	1277.00	1278.00	1279.00	1280.00

STORAGE	564.00
OUTFLOW	10420.00
ELEVATION	1281.00

*** *** *** *** ***

HYDROGRAPH AT STATION GUAD_DAM

PEAK OUTFLOW IS 1167. AT TIME 3.92 HOURS

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	12.42-HR
1167.	3.92	(CFS)	379.	191.	191.	191.
		(INCHES)	1.803	1.879	1.879	1.879
		(AC-FT)	188.	196.	196.	196.

PEAK STORAGE (AC-FT)	TIME (HR)	MAXIMUM AVERAGE STORAGE 6-HR	24-HR	72-HR	12.42-HR
389.	3.92	353.	278.	278.	278.

PEAK STAGE (FEET)	TIME (HR)	MAXIMUM AVERAGE STAGE 6-HR	24-HR	72-HR	12.42-HR
1276.02	3.92	1274.83	1270.56	1270.56	1270.56

CUMULATIVE AREA = 1.95 SQ MI

STATION GUAD_DAM

(I) INFLOW, (O) OUTFLOW

	0.	400.	800.	1200.	1600.	2000.	2400.	2800.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	(S) STORAGE 100.	200.	300.	400.	0.	0.
DAHRMN	PER												
301200	1	I						S					
301205	2	I						S					
301210	3	I						S					
301215	4	I						S					
301220	5	I						S					
301225	6	I						S					
301230	7	I						S					
301235	80	I						S					
301240	90	I						S					
301245	100	I						S					
301250	110	. I						S					
301255	120	I						S					
301300	130	I						S					
301305	140	I						.S					
301310	150	I						.S					
301315	160	I						.S					
301320	170	. I						.S					
301325	180	. I						. S					
301330	190	. I						. S					
301335	200	. I						. S					
301340	210	. . . . . .I.						. S					
301345	220	. I						. S					
301350	230	. I						. S					
301355	240	. I						. S					
301400	250	. I						. S					
301405	260	. I						. S					
301410	270	. I						. S					
301415	280	. I						. S					
301420	290	. I						. S					
301425	300	. I						. S					
301430	310	. . . . . .I.						. S					
301435	320	. I						. S					
301440	330	. I						. S					
301445	340	. I						. S					
301450	350	. I						. S					
301455	360	. I						. S					
301500	370	. I						. S					
301505	380	. I						. S					
301510	390	. I						. S					
301515	40.	O .					I	. S					
301520	41.	. . .O.						. S.					
301525	42.	. O				I		. S					
301530	43.	. 0.				I		. S					
301535	44.	. O				I		. S					
301540	45.	. 0			I			. S					
301545	46.	. 0	I					. S.					
301550	47.	. 0. I						. S.					
301555	48.	. 0I						. S.					
301600	49.	. I 0.						. S.					
301605	50.	. I 0						. S.					
301610	51.	. . . I . .0.						. S.					
301615	52.	. I 0						. S					
301620	53.	. I . 0						. S					

```
301625  54.         .     I   .   O     .         .         .         .         .         .         .       S .         .         .
301630  55.         .   I     . O       .         .         .         .         .         .         .       S .         .         .
301635  56.         .  I      .O        .         .         .         .         .         .         .       S .         .         .

301640  57.         . I      O.         .         .         .         .         .         .         .      S  .         .         .
301645  58.         .I      O .         .         .         .         .         .         .         .      S  .         .         .
301650  59.         I      O  .         .         .         .         .         .         .         .      S  .         .         .
301655  60.        I.    O    .         .         .         .         .         .         .         .      S  .         .         .
301700  61. . . . I . . O . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . S. . . . . . . . . . . .
301705  62.      I  .  O      .         .         .         .         .         .         .         .      S  .         .         .
301710  63.      I  . O       .         .         .         .         .         .         .         .     S   .         .         .
301715  64.     I   .O        .         .         .         .         .         .         .         .     S   .         .         .
301720  65.    I    O         .         .         .         .         .         .         .         .     S   .         .         .
301725  66.    I   O.         .         .         .         .         .         .         .         .     S   .         .         .
301730  67.    I   O.         .         .         .         .         .         .         .         .     S   .         .         .
301735  68.   I   O .         .         .         .         .         .         .         .         .     S   .         .         .
301740  69.   I   O .         .         .         .         .         .         .         .         .     S   .         .         .
301745  70.  I   O  .         .         .         .         .         .         .         .         .     S   .         .         .
301750  71. .I. .O. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . S. . . . . . . . . . . .
301755  72.  I   O  .         .         .         .         .         .         .         .         .    S    .         .         .
301800  73.  I   O  .         .         .         .         .         .         .         .         .    S    .         .         .
301805  74. I   O   .         .         .         .         .         .         .         .         .    S    .         .         .
301810  75. I   O   .         .         .         .         .         .         .         .         .    S    .         .         .
301815  76. I   O   .         .         .         .         .         .         .         .         .    S    .         .         .
301820  77. I   O   .         .         .         .         .         .         .         .         .    S    .         .         .
301825  78. I  O    .         .         .         .         .         .         .         .         .    S    .         .         .
301830  79. I  O    .         .         .         .         .         .         .         .         .    S    .         .         .
301835  80.I   O    .         .         .         .         .         .         .         .         .    S    .         .         .
301840  81.I. .O. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . S . . . . . . . . . . . . .
301845  82.I  O     .         .         .         .         .         .         .         .         .   S     .         .         .
301850  83.I  O     .         .         .         .         .         .         .         .         .   S     .         .         .
301855  84.I  O     .         .         .         .         .         .         .         .         .   S     .         .         .
301900  85.I  O     .         .         .         .         .         .         .         .         .   S     .         .         .
301905  86.I  O     .         .         .         .         .         .         .         .         .   S     .         .         .
301910  87.I O      .         .         .         .         .         .         .         .         .   S     .         .         .
301915  88.I O      .         .         .         .         .         .         .         .         .   S     .         .         .
301920  89.I O      .         .         .         .         .         .         .         .         .   S     .         .         .
301925  90.I O      .         .         .         .         .         .         .         .         .   S     .         .         .
301930  91.I.O. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . S . . . . . . . . . . . . .
301935  92.I O      .         .         .         .         .         .         .         .         .   S     .         .         .
301940  93.IO       .         .         .         .         .         .         .         .         .   S     .         .         .
301945  94.IO       .         .         .         .         .         .         .         .         .   S     .         .         .
301950  95.IO       .         .         .         .         .         .         .         .         .  S      .         .         .
301955  96.IO       .         .         .         .         .         .         .         .         .  S      .         .         .
302000  97I O       .         .         .         .         .         .         .         .         .  S      .         .         .
302005  98I O       .         .         .         .         .         .         .         .         .  S      .         .         .
302010  99I O       .         .         .         .         .         .         .         .         .  S      .         .         .
302015 100I O       .         .         .         .         .         .         .         .         .  S      .         .         .
302020 101I O . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . S. . . . . . . . . . . . .
302025 102I O       .         .         .         .         .         .         .         .         .  S      .         .         .
302030 103IO        .         .         .         .         .         .         .         .         .  S      .         .         .
302035 104IO        .         .         .         .         .         .         .         .         .  S      .         .         .
302040 105IO        .         .         .         .         .         .         .         .         .  S      .         .         .
302045 106IO        .         .         .         .         .         .         .         .         .  S      .         .         .
302050 107IO        .         .         .         .         .         .         .         .         .  S      .         .         .
302055 108IO        .         .         .         .         .         .         .         .         .  S      .         .         .
302100 109IO        .         .         .         .         .         .         .         .         .  S      .         .         .
302105 110IO        .         .         .         .         .         .         .         .         .  S      .         .         .
302110 111IO. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . S. . . . . . . . . . . . .
302115 112IO        .         .         .         .         .         .         .         .         .  S      .         .         .
302120 113IO        .         .         .         .         .         .         .         .         .  S      .         .         .
302125 114IO        .         .         .         .         .         .         .         .         .  S      .         .         .
302130 115IO        .         .         .         .         .         .         .         .         .  S      .         .         .
302135 116IO        .         .         .         .         .         .         .         .         .  S      .         .         .
```

```
302140 117I0
302145 118I0
302150 119I0


302155 120I0
302200 121I0
302205 122I0
302210 123I0
302215 124I0
302220 125I
302225 126I
302230 127I
302235 128I
302240 129I
302245 130I
302250 131I
302255 132I
302300 133I
302305 134I
302310 135I
302315 136I
302320 137I
302325 138I
302330 139I
302335 140I
302340 141I
302345 142I
302350 143I
302355 144I
 10000 145I
 10005 146I
 10010 147I
 10015 148I
 10020 149I
 10025 150I
```

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	SUB1	526.	2.25	195.	94.	94.	.35		
HYDROGRAPH AT	SUB2	820.	2.33	322.	156.	156.	.57		
2 COMBINED AT	COMB	1340.	2.25	517.	250.	250.	.92		
ROUTED TO	ROUTE	1332.	2.42	516.	250.	250.	.92		
HYDROGRAPH AT	SUB3	776.	2.25	294.	142.	142.	.52		
2 COMBINED AT	COMB	2103.	2.33	809.	392.	392.	1.44		
ROUTED TO	ROUTE	2057.	2.58	799.	391.	391.	1.44		
HYDROGRAPH AT	SUB4	749.	2.08	243.	117.	117.	.52		
2 COMBINED AT	COMB	2604.	2.50	1038.	508.	508.	1.95		
ROUTED TO	GUAD_DAM	1167.	3.92	379.	191.	191.	1.95	1276.02	3.92

SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION GUAD_DAM

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1250.00	1274.00	1281.00
STORAGE	0.	328.	564.
OUTFLOW	0.	19.	10420.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1276.02	.00	389.	1167.	.00	3.92	.00

*** NORMAL END OF HEC-1 ***
STOP
)
)
END OF FILE
AOS/VS CLI TERMINATING 10-AUG-88 13:25:12

PROCESS 78 TERMINATED
ELAPSED TIME 0:00:20
(OTHER JOBS, SAME USERNAME:
NUMBER OF CONSOLE JOBS, 1
NUMBER OF BATCH JOBS, 0)
USER 'HYD.DJP' LOGGED OFF 10-AUG-88 13:25:12

****
*LIST FILE EMPTY, WILL NOT BE PRINTED
****

HYDROGRAPH COMBINING AND ROUTING

HYDROLOGIC ENGINEERING CENTER
COMPUTER PROGRAM 23-J2- L232

AUGUST 1966

U. S. ARMY ENGINEER DISTRICT
650 CAPITOL MALL
SACRAMENTO, CALIFORNIA

HYDROGRAPH COMBINING AND ROUTING

HYDROLOGIC ENGINEERING CENTER
COMPUTER PROGRAM 23-J2-L232

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EXHIBITS

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2	TEST INPUT
3	TEST OUTPUT
4	DEFINITIONS
5	SOURCE PROGRAM
6	INPUT DATA
7	SUMMARY OF REQUIRED CARDS

HYDROGRAPH COMBINING AND ROUTING

HYDROLOGIC ENGINEERING CENTER
COMPUTER PROGRAM 23-J2-L232

1. ORIGIN OF PROGRAM

This program was prepared in the Hydrologic Engineering Center, Corps of Engineers, 650 Capitol Mall, Sacramento, California, principally by Leo R. Beard. Up-to-date information and copies of source statement cards for various types of computers can be obtained from the Center upon request by Government and cooperating organizations.

2. PURPOSE OF PROGRAM

a. This program written in Fortran II will route hydrographs through river channels, given routing coefficients, and through reservoirs, given a table of fixed storage-outflow relation, for a river basin of any size and complexity to accomplish any one of the following:

(1) Given reservoir hold-outs and observed hydrographs downstream, compute unregulated flows

(2) Given observed or unregulated flows, compute local inflows

(3) Given hydrographs for all sub-areas (and local flows at combining points, if any), compute routed and combined hydrographs.

b. The program is also practical for single routings. Specified ratios of input hydrographs can be routed, and any combination of uniform and coefficient channel losses can be used.

c. Choices of methods for each routing are:

(1) Puls method for reservoir routings, where outflow is a function of storage only.

(2) Successive Puls method for channel routing, which is similar to that used in Columbia River Basin studies Program 24-J3-H001.

(3) Puls-lag method for channel routing, which uses storage-outflow table, and lag of an exact multiple of routing interval.

(4) Muskingum method for channel routing with K, X and number of identical reaches given.

(5) Tatum method for channel routing with number of steps designated as NTATM.

(6) Straddle-stagger method for channel routing.

d. Routing through reservoirs with downstream control and intermediate uncontrolled runoff is not possible with this program as written.

e. A listing of the source program and test input and output data are given at the end of this report.

3. DESCRIPTION OF EQUIPMENT

a. This program was prepared for use on the IBM 1620 computer with 40,000 digit, variable word length memory, card input and output, and is usable in the GE 225 and RCA 301 computers having comparable memory.

b. Source decks for these and other types of computers are available in the Hydrologic Engineering Center.

4. METHODS OF COMPUTATION

a. Procedures for routing are described in EM 1110-2-1408, "Routing of Floods Through River Channels", in ES-171 Technical Bulletin No. 22 (Multiple Storage), and in Handbook of Applied Hydrology, by Ven Te Chow. These are briefly described as follows:

(1) Puls: Outflow is a function of storage and therefore of storage indication (S+Q/2), which is determined from equation 1.

$$(S_2+O_2/2) = (S_1+O_1/2)+I_{1,2}-O_1 \qquad (1)$$

(2) Muskingum: Outflow is a function of prism and wedge storage, which are functions of inflow and outflow, determined as follows:

$$O_2 = (C_1-C_2)\ I_1+C_2\ (I_2+O_1) \qquad (2)$$

$$C_1 = 2(\Delta t)/(2K(1-X)+\Delta t) \qquad (3)$$

$$C_2 = (\Delta t-2KX)/(2K(1-X)+\Delta t) \qquad (4)$$

(3) Tatum: Instantaneous flows a routing interval apart are averaged to obtain new instantaneous flow at end of interval. This procedure is repeated until the number of steps (NTATM) times the routing interval is equal to twice the travel time for the reach. The routing interval can be longer (an exact multiple) than the inflow interval, to cause greater storage effect.

(4) Straddle-stagger: Successive inflows numbering NSTRL (at least 2) are averaged and the average is lagged LAG intervals beyond middle of range over which flows were averaged. In order to have outflows on correct timing, 1/2 time interval is added by program to specified value of LAG if straddle (NSTRL) is an even number. Thus, Tatum routing can be effected (but less efficiently) by specifying NRCHS (number of reaches) instead of NTATM as number of Tatum steps and 2 for NSTRL and zero for LAG.

b. Hydrographs can be routed and combined downstream at any interval that is an exact multiple of the input interval. All hydrographs must be read and must begin at the same time, but may be tabulated at different intervals that are exact multiples of each other. All routings (except Tatum, where it is not necessary can be repeated any number of times, using previous outflow for new inflow, without intermediate print-out. Hydrograph output from program 23-J2-L228, Unit Hydrograph and Hydrograph Computation, can be used directly for input to this program. All routing procedures include the assumption that flow has been uniform prior to the beginning of each hydrograph at the flow rate of its first ordinate.

5. INPUT

a. Input for hydrograph reading and routing and combining operations are summarized at the end of the text. All data are entered consecutively on each card, using 8 columns (digits, including decimal, if used) per variable and 10 variables per card, unless fewer variables are called for, except column 1 of each card is reserved for identification of the card series (A-F) and not read by the computer. Thus, the first field on each card is limited to 7 columns.

b. Each hydrograph (C, D) to be routed (local inflow is not routed) must be followed by routing cards (E, F). Whenever a hydrograph card contains a non-negative value or routing card contains a positive value for NHGT (which calls for a combining operation) the operation must be followed by the routing cards, unless it is the last operation for the run (positive value for FIN). If the hydrograph specification card contains a negative value of NHGT, the operation must be followed by another set of hydrograph cards. Accordingly, NHGT should be left blank except as follows:

(1) NHGT should be the number of hydrographs to be combined immediately following the operation in which it is located.

(2) NHGT should be -1 if one hydrograph operation is to be followed by another without an intermediate routing operation.

c. Hydrographs are stored automatically in the lowest available computer locations, and the highest locations used for hydrograph storage are released as soon as hydrographs are combined at a combining point. Hydrographs combined are those in the highest computer locations, so once a hydrograph above any combining point is read, all remaining hydrographs above that combining point must be read before any others, so that they will be in the highest computer locations. Local inflow or observed flow, if any, should be read last, since it calls for a combining operation. Since only a limited number of hydrographs can be retained in memory at any one time, the first hydrograph read above any combining point should be one of those having the most combining points to pass through in order to reach the final combining point of the system, so that hydrographs are not stored before they are needed. All routings to the same combining point must have the same outflow interval, but local inflow can have a shorter tabulation interval (exact fraction). Ordinates are normally in cfs at end of each interval (ITQI). However, average values in cfs can be entered if a positive value of IQAVG is given.

d. All values of ITQI (C3) ITQR (E1) and ITQO (E2) should for purposes of standardization be 5, 15 or 30 minutes or 1, 2, 6, 12 or 24 hours expressed in minutes. No routing or outflow interval (ITQO or ITQR) can be shorter than the longest upstream hydrograph interval (ITQI) or upstream outflow interval (ITQO).

e. LNGTH is length of flood in hours and cannot exceed KQ (see Fortran listing) times shortest interval used for any ITQI, ITQR or ITQO.

f. At the end of each run (complete basin routing for one flood) data for the next run will be accepted.

6. OUTPUT

a. Input (including hydrograph tabulations, if IPNCH is positive)

b. Routed hydrograph in cfs at end of each reach

c. Combined hydrograph (or derived local flow) in cfs at each combining point

d. Reservoir inflow and outflow in cfs and storage in acre-feet.

7. OPERATING INSTRUCTIONS

Standard Fortran II operating instructions. No sense switches used.

8. DEFINITION OF TERMS

Terms used in this program are defined at the end of the text.

9. EXAMPLE

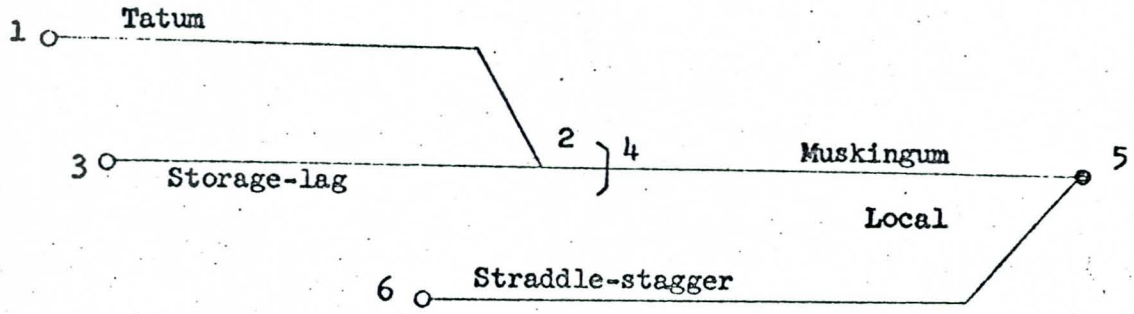
An example of each of the 3 basic program applications is given as Exhibits 1, 2 and 3.

10. PROPOSED FUTURE DEVELOPMENT

a. It is anticipated that additions to this program will be made from time to time. Alternative methods of routing and inclusion of remote downstream controls on reservoir releases are contemplated.

b. It is requested that any user of this program who finds an inadequacy or desirable addition or modification notify the Hydrologic Engineering Center.

TEST DATA SEQUENCE
23-J2-L232



Type of Input		Inflow location LOCI	Outflow location LOCO	Combine hydrographs NHGT	End of run FIN
COMPUTING UNREGULATED FLOWS ROUTINE					
Three output title cards					
Basin data card					
Holdouts	(C,D)	4			
Routing	(E)	4	5		
Hydrograph	(C,D)	5		2	1
COMPUTING LOCAL FLOWS ROUTINE					
Three output title cards					
Basin data card					
Hydrograph	(C,D)	4			
Routing	(E)	4	5		
Hydrograph	(C,D)	6			
Routing	(E)	6	5		
Hydrograph	(C,D)	5		3	1
HYDROGRAPH COMBINING ROUTINE					
Three output title cards					
Basin data card					
Hydrograph	(C,D)	1			
Routing	(E)	1	2		
Hydrograph	(C,D)	3			
Routing	(E,F)	3	2	2	
Routing	(E,F)	2	4		
Routing	(E)	4	5		
Hydrograph	(C,D)	6			
Routing	(E)	6	5		
Hydrograph	(C,D)	5		3	1

EXHIBIT 1

(14, 10)
(160, 10)

SAMPLE INPUT

F2 A

110

```
A                              TEST NO. 1
A          HYDROGRAPH COMBINING AND ROUTING PROGRAM
A            COMPUTING UNREGULATED FLOWS ROUTINE
B     1          66      5      17      65    1200
C     4    66    60
D                                    36      73     218     351     448     544
D   617   690   726   774   859   968  1065  1162  1246  1307
D  1367  1404  1428  1500  1585  1718  1924  2190  2493  2686
D  2735  2638  2493  2311  2069  2287  1537  1234   968   702
D   448   230    36  -133  -254  -339  -411  -436  -448  -496
D  -520  -557  -593  -605  -605  -629  -629  -641  -629  -641
D  -629  -629  -629  -617  -617  -605
E    60   120     1     5
E   3.2    .2
C     5    33   120                                    2      1
D    76   124   343   535   671   807   983  1317  1617  1809
D  1995  2300  2802  3566  3822  3573  3463  3239  2897  2496
D  1970  1465  1129   869   631   463   369   318   290   264
D   233   211   198
A                              TEST NO. 2
A          HYDROGRAPH COMBINING AND ROUTING PROGRAM
A            COMPUTING LOCAL INFLOWS ROUTINE
B           1    66      5      17      65    1200
C     4    66    60
D   192    44   186    60   200   200   202   205   209   213
D   218   224   230   237   244   252   260   270   280   291
D   304   321   339   358   377   399   422   449   482   516
D   552   586   618   648   674   698   717   734   746   755
D   761   764   764   763   759   755   750   744   738   732
D   725   718   710   702   694   686   678   670   662   654
D   645   637   629   621   613   605
E    60   120           5
E   3.2    .2
C     6    30   120
D     8    50   262   457   541   584   648   863  1038  1103
D  1166  1348  1722  2332  2398  1868  1478  1096   714   429
D   222   109   104   121    85    40    19     9     4     2
E   120   120     1     5           3     4
E
C     5    33   120                                    3      1
D    76   124   343   535   671   807   983  1317  1617  1809
```

EXHIBIT 2

EXHIBIT 2

```
D  1995  2300  2802  3566  3822  3573  3463  3239  2897  2496
D  1970  1465  1129   869   631   463   369   318   290   264
D   233   211   198
A                    TEST NO. 3
A          HYDROGRAPH COMBINING AND ROUTING PROGRAM
A                  HYDROGRAPH COMBINING ROUTINE
B                    66     5    17    65  1200
C     1    60    60   .90                 1
D    76    53    83   267   489   599   580   570   637   625
D   598   617   691   845   955   974  1001  1044  1045  1026
D  1033  1087  1230  1360  1532  1836  2316  2427  2061  1756
D  1515  1348  1207  1004   807   651   518   413   292   192
D   124    86    61    56   109   163   148   102    66    43
D     8    18    12     8     5     3     1     0     0
E    60    60           2     3
F                   20   .10
C     3    60    60
D    76    53    83   267   489   599   580   570   637   625
D   598   617   691   845   955   974  1001  1044  1045  1026
D  1033  1087  1230  1360  1532  1836  2316  2427  2061  1756
D  1515  1348  1207  1004   807   651   518   413   292   192
D   124    86    61    56   109   163   148   102    66    43
D     8    18    12     8     5     3     1     0     0
E    60    60     2     2           1           2    -1
E                                   2
F     0     0  2000  1000
E    60    60     1     4                       5    -1    43
E                                   1
F  5000        5000   200  6000   300  7000   450  9000   760
E    60   120     1     5
E   3.2    .2
C     6    30   120
D     8    50   262   457   541   584   648   863  1038  1103
D  1166  1348  1722  2332  2398  1868  1478  1096   714   429
D   222   109   104   121    85    40    19     9     4     2
E   120   120     1     5           3     4
E
C     5    30   120                       3     1
D     8    50   262   457   541   584   648   863  1038  1103
D  1166  1348  1722  2332  2398  1868  1478  1096   714   429
D   222   109   104   121    85    40    19     9     4     2
```

1

SAMPLE OUTPUT

TEST NO. 1

HYDROGRAPH COMBINING AND ROUTING PROGRAM

COMPUTING UNREGULATED FLOWS ROUTINE

IUNRG	LOCAL	LNGTH	IMNTH	IDAY	IYR	ITIME	RATIO
1	0	66	5	17	65	.1200	0.00

LOCI	NQI	ITQI	RTIO	IQAVG	IPNCH	NHGT	FIN
4	66	60	0.00	0	0	0	0.

FLOW AT 4 MULTIPLIED BY 1.000

0.	0.	0.	0.	36.	73.	218.	351.	448.	544.
617.	690.	726.	774.	859.	968.	1065.	1162.	1246.	1307.
1367.	1404.	1428.	1500.	1585.	1718.	1924.	2190.	2493.	2686.
2735.	2638.	2493.	2311.	2069.	2287.	1537.	1234.	968.	702.
448.	230.	36.	-133.	-254.	-339.	-411.	-436.	-448.	-496.
-520.	-557.	-593.	-605.	-605.	-629.	-629.	-641.	-629.	-641.
-629.	-629.	-629.	-617.	-617.	-605.				

ITQR	ITQO	NRCHS	LOCO	NTATM	LAG	NSTRL	NPULS	STORA	RES
60	120	1	5	0	0	0	0	0.	0.

AMSKK	X	QLOSS	CQLOS	NHGT	FIN
3.200	.200	0.0	0.000	0	0.

HYDROGRAPH 4 ROUTED TO 5 NO. FLOWS= 33 INTERVAL= 120 MINUTES

0.	0.	8.	80.	252.	430.	580.	706.	873.	1053.
1208.	1319.	1437.	1639.	2021.	2404.	2497.	2314.	2091.	1556.
1024.	540.	140.	-141.	-304.	-414.	-502.	-557.	-596.	-616.
-626.	-628.	-622.							

LOCI	NQI	ITQI	RTIO	IQAVG	IPNCH	NHGT	FIN
5	33	120	0.00	0	0	2	1.

FLOW AT 5 MULTIPLIED BY 1.000

76.	124.	343.	535.	671.	807.	983.	1317.	1617.	1809.
1995.	2300.	2802.	3566.	3822.	3573.	3463.	3239.	2897.	2496.
1970.	1465.	1129.	869.	631.	463.	369.	318.	290.	264.
233.	211.	198.							

UNREGULATED FLOW

EXHIBIT 3

EXHIBIT 3

AT 5 NQ= 33 120-MIN INTRVL

76.	124.	351.	615.	923.	1237.	1563.	2023.	2490.	2862.
3203.	3619.	4239.	5205.	5843.	5977.	5960.	5553.	4988.	4052.
2994.	2005.	1269.	727.	326.	48.	-133.	-239.	-306.	-352.
-393.	-417.	-424.							

2

TEST NO. 2
HYDROGRAPH COMBINING AND ROUTING PROGRAM
COMPUTING LOCAL INFLOWS ROUTINE

IUNRG	LOCAL	LNGTH	IMNTH	IDAY	IYR	ITIME	RATIO
0	1	66	5	17	65	1200	0.00

LOCI	NQI	ITQI	RTIO	IQAVG	IPNCH	NHGT	FIN
4	66	60	0.00	0	0	0	0.

FLOW AT 4 MULTIPLIED BY 1.000

192.	44.	186.	60.	200.	200.	202.	205.	209.	213.
218.	224.	230.	237.	244.	252.	260.	270.	280.	291.
304.	321.	339.	358.	377.	399.	422.	449.	482.	516.
552.	586.	618.	648.	674.	698.	717.	734.	746.	755.
761.	764.	764.	763.	759.	755.	750.	744.	738.	732.
725.	718.	710.	702.	694.	686.	678.	670.	662.	654.
645.	637.	629.	621.	613.	605.				

ITQR	ITQO	NRCHS	LOCO	NTATM	LAG	NSTRL	NPULS	STORA	RES
60	120	1	5	0	0	0	0	0.	0.

AMSKK	X	QLOSS	CQLOS	NHGT	FIN
3.200	.200	0.0	0.000	0	0.

HYDROGRAPH 4 ROUTED TO 5 NO. FLOWS= 33 INTERVAL= 120 MINUTES

198.	161.	147.	176.	193.	205.	216.	229.	243.	260.
280.	307.	339.	377.	424.	483.	547.	609.	662.	704.
734.	750.	756.	754.	747.	737.	724.	710.	695.	679.
663.	647.	630.							

LOCI	NQI	ITQI	RTIO	IQAVG	IPNCH	NHGT	FIN
6	30	120	0.00	0	0	0	0.

FLOW AT 6 MULTIPLIED BY 1.000

8.	50.	262.	457.	541.	584.	648.	863.	1038.	1103.
1166.	1348.	1722.	2332.	2398.	1868.	1478.	1096.	714.	429.
222.	109.	104.	121.	85.	40.	19.	9.	4.	2.

ITQR	ITQO	NRCHS	LOCO	NTATM	LAG	NSTRL	NPULS	STORA	RES
120	120	1	5	0	3	4	0	0.	0.

AMSKK	X	QLOSS	CQLOS	NHGT	FIN

EXHIBIT 3

0.000	0.000	0.0	0.000	0	0.	

HYDROGRAPH 6 ROUTED TO 5 NO. FLOWS= 33 INTERVAL= 120 MINUTES

8.	8.	8.	18.	82.	194.	327.	461.	557.	659.
783.	913.	1042.	1163.	1334.	1642.	1950.	2080.	2019.	1710.
1289.	929.	615.	368.	216.	139.	104.	87.	66.	38.
18.	8.	3.							

LOCI	NQI	ITQI	RTIO	IQAVG	IPNCH	NHGT	FIN
5	33	120	0.00	0	0	3	1.

FLOW AT 5 MULTIPLIED BY 1.000

76.	124.	343.	535.	671.	807.	983.	1317.	1617.	1809.
1995.	2300.	2802.	3566.	3822.	3573.	3463.	3239.	2897.	2496.
1970.	1465.	1129.	869.	631.	463.	369.	318.	290.	264.
233.	211.	198.							

LOCAL FLOW
AT 5 NQ= 33 120-MIN INTRVL

-130.	-45.	187.	339.	395.	407.	438.	626.	815.	889.
931.	1080.	1420.	2024.	2062.	1447.	965.	549.	215.	81.
-53.	-214.	-242.	-254.	-332.	-413.	-460.	-479.	-471.	-453.
-448.	-444.	-436.							

1

TEST NO. 3
HYDROGRAPH COMBINING AND ROUTING PROGRAM
HYDROGRAPH COMBINING ROUTINE

IUNRG	LOCAL	LNGTH	IMNTH	IDAY	IYR	ITIME	RATIO		
0	0	66	5	17	65	1200	0.00		
LOCI	NQI	ITQI	RTIO	IQAVG	IPNCH	NHGT	FIN		
1	60	60	.90	0	1	0	0.		
76.	53.	83.	267.	489.	599.	580.	570.	637.	625.
598.	617.	691.	845.	955.	974.	1001.	1044.	1045.	1026.
1033.	1087.	1230.	1360.	1532.	1836.	2316.	2427.	2061.	1756.
1515.	1348.	1207.	1004.	807.	651.	518.	413.	292.	192.
124.	86.	61.	56.	109.	163.	148.	102.	66.	43.
8.	18.	12.	8.	5.	3.	1.	0.	0.	0.
FLOW AT	1	MULTIPLIED BY	.900						
68.	47.	74.	240.	440.	539.	522.	513.	573.	562.
538.	555.	621.	760.	859.	876.	900.	939.	940.	923.
929.	978.	1107.	1224.	1378.	1652.	2084.	2184.	1854.	1580.
1363.	1213.	1086.	903.	726.	585.	466.	371.	262.	172.
111.	77.	54.	50.	98.	146.	133.	91.	59.	38.
7.	16.	10.	7.	4.	2.	0.	0.	0.	0.
ITQR	ITQO	NRCHS	LOCO	NTATM	LAG	NSTRL	NPULS	STORA	RES
60	60	1	2	3	0	0	0	0.	0.
AMSKK	X	QLOSS	CQLOS	NHGT	FIN				
0.000	0.000	20.0	.100	0	0.				
HYDROGRAPH	1	ROUTED TO	2	NO. FLOWS=	66	INTERVAL=	60 MINUTES		
43.	41.	37.	58.	143.	280.	398.	447.	456.	470.
483.	480.	484.	525.	607.	697.	754.	784.	807.	821.
821.	823.	854.	927.	1033.	1170.	1377.	1643.	1817.	1757.
1540.	1320.	1151.	1013.	871.	720.	578.	460.	360.	268.
183.	116.	71.	44.	37.	54.	85.	97.	81.	52.
26.	5.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.				
LOCI	NQI	ITQI	RTIO	IQAVG	IPNCH	NHGT	FIN		
3	60	60	0.00	0	0	0	0.		

EXHIBIT 3

EXHIBIT 3

FLOW AT 3 MULTIPLIED BY 1.000

76.	53.	83.	267.	489.	599.	580.	570.	637.	625.
598.	617.	691.	845.	955.	974.	1001.	1044.	1045.	1026.
1033.	1087.	1230.	1360.	1532.	1836.	2316.	2427.	2061.	1756.
1515.	1348.	1207.	1004.	807.	651.	518.	413.	292.	192.
124.	86.	61.	56.	109.	163.	148.	102.	66.	43.
8.	18.	12.	8.	5.	3.	1.	0.	0.	0.

ITQR	ITQO	NRCHS	LOCO	NTATM	LAG	NSTRL	NPULS	STORA	RES
60	60	2	2	0	1	0	2	-1.	0.

AMSKK	X	QLOSS	CQLOS	NHGT	FIN
0.000	0.000	0.0	0.000	2	0.

STOR-OUTFLOW TABLE

0.	0.	2000.	10000.

HYDROGRAPH 3 ROUTED TO 2 NO. FLOWS= 66 INTERVAL= 60 MINUTES

PER	INFLOW	OUTFLOW	STOR						

HYDROGRAPH 3 ROUTED TO 2 NO. FLOWS= 66 INTERVAL= 60 MINUTES

76.	76.	76.	75.	73.	78.	104.	157.	227.	300.
365.	422.	471.	508.	538.	572.	617.	673.	733.	791.
844.	890.	927.	956.	987.	1028.	1086.	1167.	1286.	1447.
1618.	1745.	1803.	1797.	1742.	1654.	1540.	1405.	1260.	1110.
963.	822.	688.	564.	455.	362.	288.	235.	201.	180.
161.	143.	122.	101.	82.	66.	52.	40.	31.	23.
17.	12.	9.	6.	4.	3.				

COMBINED HYDROGRAPH
AT 2 NQ= 66 60-MIN INTRVL

119.	117.	113.	133.	217.	359.	502.	604.	684.	770.
848.	903.	955.	1033.	1146.	1269.	1372.	1457.	1541.	1613.
1665.	1713.	1781.	1884.	2021.	2199.	2463.	2811.	3103.	3205.
3158.	3066.	2955.	2810.	2614.	2374.	2118.	1866.	1620.	1378.
1147.	938.	759.	609.	492.	417.	373.	332.	282.	232.
188.	149.	122.	101.	82.	66.	52.	40.	31.	23.
17.	12.	9.	6.	4.	3.				

ITQR	ITQO	NRCHS	LOCO	NTATM	LAG	NSTRL	NPULS	STORA	RES
60	60	1	4	0	0	0	5	-1.	43.

AMSKK	X	QLOSS	CQLOS	NHGT	FIN

0.000 0.000 0.0 0.000 1 0.

STOR-OUTFLOW TABLE

5000. 0. 5000. 200. 6000. 300. 7000. 450.
9000. 760.

HYDROGRAPH 2 ROUTED TO 4 NO. FLOWS= 66 INTERVAL= 60 MINUTES

PER	INFLOW	OUTFLOW	STOR
1	119.	110.	5000.
2	118.	126.	5000.
3	115.	104.	5000.
4	123.	142.	5000.
5	175.	200.	5000.
6	288.	200.	5008.
7	431.	202.	5027.
8	553.	205.	5056.
9	644.	209.	5092.
10	727.	213.	5134.
11	809.	218.	5183.
12	876.	223.	5238.
13	929.	229.	5296.
14	994.	235.	5359.
15	1090.	242.	5429.
16	1207.	250.	5508.
17	1320.	259.	5596.
18	1414.	269.	5691.
19	1499.	279.	5793.
20	1577.	289.	5900.
21	1639.	301.	6011.
22	1689.	318.	6125.
23	1747.	336.	6242.
24	1833.	354.	6365.
25	1952.	374.	6496.
26	2110.	395.	6639.
27	2331.	419.	6798.
28	2637.	446.	6980.
29	2957.	478.	7186.
30	3154.	512.	7406.
31	3181.	546.	7625.
32	3112.	579.	7836.

EXHIBIT 3

EXHIBIT 3

35	2712.	665.	8393.
36	2494.	689.	8543.
37	2246.	708.	8671.
38	1992.	725.	8777.
39	1743.	738.	8861.
40	1499.	748.	8923.
41	1262.	754.	8966.
42	1042.	758.	8990.
43	848.	759.	8998.
44	684.	758.	8992.
45	551.	756.	8975.
46	455.	752.	8950.
47	395.	747.	8921.
48	353.	742.	8888.
49	307.	737.	8853.
50	257.	730.	8813.
51	210.	724.	8770.
52	168.	717.	8725.
53	135.	709.	8677.
54	112.	702.	8628.
55	92.	694.	8579.
56	74.	686.	8527.
57	59.	678.	8476.
58	46.	670.	8424.
59	35.	662.	8371.
60	27.	654.	8319.
61	20.	646.	8267.
62	15.	638.	8215.
63	10.	630.	8163.
64	7.	622.	8112.
65	5.	614.	8062.
66	3.	606.	8011.

ITQR	ITQO	NRCHS	LOCO	NTATM	LAG	NSTRL	NPULS	STORA	RES
60	120	1	5	0	0	0	0	0.	0.
AMSKK	X	QLOSS	CQLOS	NHGT	FIN				
3.200	.200	0.0	0.000	0	0.				

HYDROGRAPH 4 ROUTED TO 5 NO. FLOWS= 33 INTERVAL= 120 MINUTES

109.	110.	144.	175.	192.	205.	216.	228.	243.	259.

279. 305. 337. 375. 422. 480. 542. 602. 654. 696.
726. 744. 751. 750. 745. 735. 723. 710. 695. 679.
664. 647. 632.

LOCI	NQI	ITQI	RTIO	IQAVG	IPNCH	NHGT	FIN
6	30	120	0.00	0	0	0	0.

FLOW AT 6 MULTIPLIED BY 1.000

8. 50. 262. 457. 541. 584. 648. 863. 1038. 1103.
1166. 1348. 1722. 2332. 2398. 1868. 1478. 1096. 714. 429.
222. 109. 104. 121. 85. 40. 19. 9. 4. 2.

ITQR	ITQO	NRCHS	LOCO	NTATM	LAG	NSTRL	NPULS	STORA	RES
120	120	1	5	0	3	4	0	0.	0.

AMSKK	X	QLOSS	CQLOS	NHGT	FIN
0.000	0.000	0.0	0.000	0	0.

HYDROGRAPH 6 ROUTED TO 5 NO. FLOWS= 33 INTERVAL= 120 MINUTES

8. 8. 8. 18. 82. 194. 327. 461. 557. 659.
783. 913. 1042. 1163. 1334. 1642. 1950. 2080. 2019. 1710.
1289. 929. 615. 368. 216. 139. 104. 87. 66. 38.
18. 8. 3.

LOCI	NQI	ITQI	RTIO	IQAVG	IPNCH	NHGT	FIN
5	30	120	0.00	0	0	3	1.

FLOW AT 5 MULTIPLIED BY 1.000

8. 50. 262. 457. 541. 584. 648. 863. 1038. 1103.
1166. 1348. 1722. 2332. 2398. 1868. 1478. 1096. 714. 429.
222. 109. 104. 121. 85. 40. 19. 9. 4. 2.

COMBINED HYDROGRAPH
AT 5 NQ= 33 120-MIN INTRVL

125. 168. 414. 651. 815. 983. 1192. 1552. 1838. 2021.
2228. 2566. 3101. 3870. 4155. 3990. 3970. 3778. 3387. 2835.
2237. 1782. 1470. 1240. 1046. 914. 847. 806. 765. 720.
682. 656. 635.

EXHIBIT 3

DEFINITIONS - 23-J2-L232

AMSKK	- Muskingum K
C1	- Routing coefficient
C2	- Routing coefficient
COEF	- Channel loss coefficient
CQLOS	- Channel loss as ratio of flow remaining after uniform loss (QLOSS) is subtracted
DISCH(K)	- Outflow in storage-outflow table
FIN	- Indicator ends run where positive
I	- Temporary index
IX	- Temporary index
IDAY	- Day of flood beginning
IMNTH	- Month number of flood beginning
IPNCH	- Indicator to punch input hydrograph when positive
IQAVG	- Indicator that inflows are average for period when positive
ITIME	- Time on 24-hour scale at start of first flood period
ITQI	- Inflow interval in minutes
ITQO(L)	- Outflow interval in minutes
ITQR	- Routing interval in minutes
IUNRG	- Indicator to compute unregulated flows when positive
IYR	- Year of flood beginning
J	- Temporary index
JX	- Temporary index
K	- Temporary index
KHYD	- Dimension limit, number of hydrographs
KQ	- Dimension limit, number of flows
KSTR	- Dimension limit, storage-discharge table
L	- Hydrograph number in computer
LAG	- Lag (translation) time of hydrograph as a multiple of ITQI
LNGTH	- Duration in hours of desired outflow tabulations
LOCAL	- Indicator for routing to compute local flow from observed flows when positive
LOCI	- Identification number of inflow location
LOCO	- Identification number of outflow location
M	- Flow index
MI	- Temporary index
MX	- Temporary index
NHGT	- Indicator calling for hydrograph combining, number of hydrographs to be combined
NOI	- Ratio of outflow to inflow interval
NPULS	- Indicator calling for Puls (storage-lag) routing, number of points to be read on storage-outflow table
NQI	- Number of inflows to be read
NQI1	- NQI-1
NQO1	- Temporary variable
NQOMX	- Number of outflows

EXHIBIT 4

NRCHS - Number of identical routings to be repeated
NRI - Ratio of routing to inflow interval
NSTRL - Number of successive flows to be averaged in straddle-stagger routing
NTATM - Number of steps in Tatum routing
Q(M,L) - Flow in cfs
QLOSS - Uniform loss in cfs
QO - Initial outflow in Puls routing
RATIO - Ratio by which all hydrographs are multiplied before routing
RTIO - Ratio by which individual hydrographs are multiplied before routing
RESQ - Indicator for reservoir routing
RSTRL - Reciprocal of NSTRL
STND - Storage indication (storage + $\frac{1}{2}$ outflow)
STORA - Storage in thousand ac-ft.
STR(K) - Storage and subsequently storage indication in table of STR versus outflow
STRDL - NSTRL
STRMN - Minimum storage in reservoir routing
TR - Routing interval in hours
X - Muskingum X

SOURCE PROGRAM LISTING

FILE HCRP

```
*05074
C     HYDROGRAPH COMBINING AND ROUTING  PROGRAM 23-J2-L232
C     HYDROLOGIC ENGINEERING CENTER          JULY 1966
C     LIBRARY SUBR NOT USED
      DIMENSION Q(150,5),STR(20),DISCH(20),ITQO(5)
      KQ=150
      KHYD=5
      KSTR=20
    1 FORMAT (1X,I7,9I8)
    2 FORMAT (1X,F7.0,9F8.0)
    3 FORMAT(10F8.0)
  100 PRINT 105
  105 FORMAT (1H1)
C                              THREE TITLE CARDS
      READ 110,(Q(I,1),I=1,120)
      PRINT 110,(Q(I,1),I=1,120)
  110 FORMAT (1X,A1,9A2,15A2,15A2)
      READ 140,IUNRG,LOCAL,LNGTH,IMNTH,IDAY,IYR,ITIME,RATIO
      IF(LNGTH)115,115,120
  112 PRINT 113
  113 FORMAT (19H DIMENSION EXCEEDED)
  115 STOP
  120 PRINT 130
  130 FORMAT(/64H   IUNRG   LOCAL   LNGTH   IMNTH    IDAY     IYR   ITIM
     1E   RATIO)
      PRINT 195, IUNRG,LOCAL,LNGTH,IMNTH,IDAY,IYR,ITIME,RATIO
  140 FORMAT (1X,I7,6I8,3F8.0)
      IF(RATIO)144,144,146
  144 RATIO = 1.
  146 L = 0
  150 L = L + 1
      IF(L-KHYD)180,180,160
  160 PRINT 170
  170 FORMAT(28H TOO MANY HYDROGRAPHS STORED)
      STOP
C                              READ HYDROGRAPH
  180 READ 182, LOCI,NQI,ITQI,RTIO,IQAVG,IPNCH,NHGT,FIN
  182 FORMAT(1X,I7,2I8,F8.0,3I8,F8.0)
      IF (KQ-LNGTH*60/ITQI) 112,185,185
  185 NQOMX=LNGTH*60/ITQI
      PRINT 190
```

EXHIBIT 5

```
190 FORMAT(/84H    LOCI     NQI     ITQI     RTIO    IQAVG    IPNCH     NHG
   1T     FIN)
    PRINT 196,LOCI,NQI,ITQI,RTIO,IQAVG,IPNCH,NHGT,FIN
195 FORMAT(7I8,F8.2)
196 FORMAT(3I8,F8.2,3I8,F8.0)
    IF(NQI-NQOMX) 220,220,200
200 PRINT 210
210 FORMAT(25H TOO MANY FLOWS FOR LNGTH)
    STOP
220 DO 230 I = NQI,NQOMX
230 Q(I,L)=0.
    READ 2, (Q(M,L),M=1,NQI)
    IF(IPNCH) 250,250,240
240 PRINT 2,(Q(M,L),M=1,NQI)
250 IF(RATIO     *RTIO) 260,260,290
260 IF(RTIO) 270,270,300
270 IF(RATIO     )330,330,280
280 RTIO=RATIO
    GO TO 300
290 RTIO=RTIO*RATIO
300 DO 310 M=1,NQI
310 Q(M,L)=Q(M,L)*RTIO
    PRINT 320,LOCI,RTIO
320 FORMAT(/8H FLOW AT16,15H  MULTIPLIED BY F8.3)
    PRINT 2,(Q(M,L),M=1,NQI)
330 IF (NHGT) 340,360,350
340 ITQO(L) = ITQI
    GO TO 150
350 ITQR=0
    RES=0.
    ITQO(L)=ITQO(L-1)
    IF(ITQI-ITQO(L)) 1080,1180,420
C                          ROUTING DATA                                  130
360 READ 361,ITQR,ITQO(L),NRCHS,LOCO,NTATM,LAG,NSTRL,NPULS,STORA,RES
361 FORMAT(1X,I7,7I8,2F8.0)
    IF (NRCHS) 364,364,366
364 NRCHS=1
366 READ 367,AMSKK,X,QLOSS,CQLOS,NHGT,FIN
367 FORMAT(1X,F7.0,3F8.0,I8,F8.0)
    PRINT 370
370 FORMAT (/80H     ITQR     ITQO    NRCHS     LOCO    NTATM      LAG    NST
```

```
     1RL   NPULS   STORA     RES)
      PRINT 361, ITQR,ITQO(L),NRCHS,LOCO,NTATM,LAG,NSTRL,NPULS,STORA,RES
      PRINT 380
  380 FORMAT (48H   AMSKK        X   QLOSS   CQLOS    NHGT     FIN)
      PRINT 390,AMSKK,X,QLOSS,CQLOS,NHGT,FIN
  390 FORMAT(2F8.3,F8.1,F8.3,I8,F8.0)
      NRI = ITQR/ITQI                                                    137
      NOI = ITQO(L)/ITQI                                                 138
C                                 DISCARD EXTRA INFLOWS                152
      IF (ITQR - ITQO(L)) 400,400,410
  400 IF (ITQR - ITQI) 420,480,460
  410 IF (ITQO(L) - ITQI) 420,480,440
  420 PRINT 430
  430 FORMAT(19H INTERVAL TOO SHORT)
      STOP
  440 NQI = NQI/NOI
      NRI = NRI/NOI
      DO 450 M = 1,NQI                                                   157
      MI = M * NOI
  450 Q(M,L) = Q(MI,L)                                                   160
      NOI = 1
      ITQI=ITQO(L)                                                       162
      GO TO 480
  460 NQI = NQI/NRI
      DO 470 M = 1,NQI
      MI = M * NRI                                                       169
  470 Q(M,L) = Q(MI,L)
      NOI = NOI/NRI                                                      171
      ITQI=ITQR
      NRI = 1                                                            175
  480 NQOMX=LNGTH*60/ITQI
      NQI1 = NQI + 1                                                     172
      DO 490 I = NQI1,NQOMX
  490 Q(I,L) = 0.
      TR = ITQI
      TR = TR/60.
C                                 ROUTING                              176
      IF (NPULS) 500,500,670
  500 NQI1=NQI-1
      IF(IQAVG) 530,530,510
  510 DO 520 I=1,NQI1
```


EXHIBIT 5

EXHIBIT 5

```
  520 Q(I,L)=(Q(I,L)+Q(I+1,L))*.5
      Q(NQI,L)=Q(NQI,L)*.5
  530 IF (AMSKK) 540,540,580
  540 IF (NSTRL) 550,550,600
  550 IF (NTATM) 560,560,1040
  560 PRINT 570
  570 FORMAT (21H NO ROUTING PERFORMED)
      GO TO 1170
C                              MUSKINGUM ROUTING
  580 C1 = 2.*TR/(2.*AMSKK*(1.-X) + TR)
      C2 = (TR-2.*AMSKK*X)/(2.*AMSKK*(1.-X)+TR)
      DO 590 K=1,NRCHS
      TEMP = Q(1,L)
C     TMP=CURRENT INFLOW   TEMP=PREVIOUS INFLOW   Q(M-1,L)=PREV OUTFLOW
FIX-> DO 590 M=2,NQOMX
      TMP = Q(M,L)
      Q(M,L) = (C1-C2)*TEMP + C2*Q(M,L)+Q(M-1,L)*(1.-C1)
  590 TEMP = TMP
      GO TO 1070
C                              STRADDLE-STRAGGER ROUTING
  600 STRDL = NSTRL
      RSTRL = 1./STRDL
      DO 660 K=1,NRCHS
      DO 660 M=1,NQOMX
C          IX = END OF STAGGER
      IX=NQOMX-M+1
C     J=START OF STRADDLE
      J = IX - NSTRL/2-LAG
C     JX = END OF STRADDLE
      JX = J+NSTRL-1
      TMP = 1.
      IF(J) 610,610,620
C     TMP IS NO OF TIMES FIRST FLOW OF FLOOD IS AVERAGED IN AT BEGINNING
  610 TMP = -J+2
      J = 1
  620 IF(JX-1) 630,630,640
  630 Q(IX,L)=Q(1,L)
      GO TO 660
  640 TEMP = TMP*Q(J,L)
      J = J + 1
      DO 650 I=J,JX
```

```
  650 TEMP = TEMP + Q(I,L)
      Q(IX,L) = TEMP*RSTRL
  660 CONTINUE
      GO TO 1070
C                              STORAGE-LAG ROUTING
  670 READ 2,(STR(I),DISCH(I),I=1,NPULS)
      PRINT 680
  680 FORMAT(19H STOR-OUTFLOW TABLE)
      PRINT 682,(STR(I),DISCH(I),I=1,NPULS)
  682 FORMAT(4(F10.0,F8.0))
      STRMN=-1.
      IF(STR(1)-STR(2)) 700,690,700
  690 STRMN=STR(1)
C     COMPUTE STORAGE INDICATION IN CFS-TR UNITS
  700 DO 710 I=1,NPULS
  710 STR(I)=STR(I)*12.1/TR+DISCH(I)*.5
      QO = Q(1,L)
      PRINT 1160,LOCI,LOCO,NQOMX,ITQO(L)
      IF(RES)722,722,715
  715 PRINT 720
  720 FORMAT(/32H      PER   INFLOW OUTFLOW    STOR)
  722 DO 1030 J=1,NRCHS
      IF(J-1)725,725,730
  725 IF(IQAVG) 730,730,750
  730 DO 740 I=2,NQI
      K = NQI-I+2
  740 Q(K,L)=(Q(K,L)+Q(K-1,L))*.5
  750 IF (RES) 758,758,754
  754 IF (STORA) 758,756,756
  756 STND = STORA*12.1/TR+QO*0.5
      GO TO 840
  758 IF(QO -DISCH(1)) 760,790,790
  760 IF(STRMN) 770,790,790
  770 PRINT 780
  780 FORMAT ( 31H OPERATING BEYOND RANGE OF DATA)
  790 DO 800 I=2,NPULS
      IF(QO-DISCH(I)) 810,810,800
  800 CONTINUE
  810 IF (DISCH(I) - DISCH(I-1)) 830,820,830
  820 STND = STR(I-1)
      GO TO 840
```

EXHIBIT 5

EXHIBIT 5

```
830 STND = (STR(I)*(QO-DISCH(I-1)) + STR(I-1)*(DISCH(I)-QO))/(DISCH
   1(I)-DISCH(I-1))
840 NQO1 = NQOMX-LAG
    DO 990 M=1,NQO1
    TMP=Q(M,L)
    IF(M-1) 850,850,860
850 STND=STND+Q(1,L)-QO
    GO TO 870
860 STND = STND+Q(M,L)-Q(M-1,L)
870 IF(STND-STR(1)) 880,910,910
880 IF(STRMN) 890,900,900
890 PRINT 780
900 I = 2
    GO TO 950
910 IF(STND-STR(NPULS)) 930,930,920
920 PRINT 780
    I=NPULS
    GO TO 950
930 DO 940 IX=2,NPULS
    I = IX
    IF(STND-STR(I)) 950,950,940
940 CONTINUE
950 IF(STR(I)-STR(I-1))954,954,957
954 Q(M,L) = DISCH(I-1)
    GO TO 958
957 Q(M,L)= (DISCH(I)*(STND-STR(I-1))+DISCH(I-1)*(STR(I)-STND))/(S
   1TR(I)-STR(I-1))
958 IF(Q(M,L)) 960,970,970
960 Q(M,L) = 0.0
970 IF(RES) 990,990,980
980 STOR=(STND-Q(M,L)*.5)*TR/12.1+.5
    TEMP=TMP
985 FORMAT (I8,2F8.0,F10.0)
    PRINT 985,M,TMP,Q(M,L),STOR
990 CONTINUE
    IF(LAG) 1030,1030,1000
1000 DO 1010 I=1,NQO1
    M = NQOMX-I+1
    MX = M-LAG
1010 Q(M,L) = Q(MX,L)
    DO 1020 M=2,LAG
```

```
 1020 Q(M,L) = Q(1,L)
      QO=Q(1,L)
 1030 CONTINUE
      GO TO 1070
C                                  TATUM ROUTING
 1040 NQI1 = NQOMX-1
 1050 DO 1060 K = 1,NTATM
      DO 1060 M = NRI,NQI1
      J = NQOMX - M + NRI                                          180
      I = J - NRI                                                  181
 1060 Q(J,L) = (Q(J,L) + Q(I,L)) * .5
C                                DISCARD EXTRA OUTFLOWS            183
 1070 IQAVG=0
      IF (ITQO(L)-ITQR)  1100,1100,1080
 1080 NOI=ITQO(L)/ITQI
      NQOMX = NQOMX/NOI                                            185
      DO 1090 M = 1,NQOMX
      MI = M * NOI                                                 187
 1090 Q(M,L) = Q(MI,L)
C              ITQR IS ZERO FOR LOCAL INFLOW
       IF (ITQR) 1180,1180,1100
C                                LOSSES                            192
 1100 IF(QLOSS+CQLOS) 1110,1140,1110
 1110 COEF = 1. - CQLOS
      DO 1130 I = 1,NQOMX
      Q(I,L) = (Q(I,L)-QLOSS) * COEF                               197
      IF(Q(I,L)) 1120,1130,1130
 1120 Q(I,L) = 0.
 1130 CONTINUE
C                              PUNCH ROUTED HYDROGRAPH
 1140 IF(RES) 1150,1150,1170
 1150 PRINT 1160,LOCI,LOCO,NQOMX,ITQO(L)
      PRINT 2,(Q(J,L),J=1,NQOMX)
 1160 FORMAT(/11H HYDROGRAPHI6,12H   ROUTED TOI6,13H   NO. FLOWS=I4,12H
     1  INTERVAL=I4,8H MINUTES)
C                                COMBINING                         206
 1170 IF(NHGT-1) 150,1360,1180
C                CHECK COMBINING INTERVAL
 1180 K = L - NHGT + 2
      DO 1210 I=K,L
      IF(ITQO(I)-ITQO(I-1)) 1190,1210,1190
```

ADD

```
 1190 PRINT 1200
 1200 FORMAT(/28H UNEQUAL COMBINING INTERVALS)
      GO TO 100
 1210 CONTINUE
      K = K -1
      J = L-1
C     PRINT OUT Q(M,IX) IX=L FOR LOCAL AND UNREG, K FOR COMBINED
      IX=L
      IF(IUNRG) 1240,1240,1220
 1220 PRINT 1230
 1230 FORMAT(/17H UNREGULATED FLOW)
      GO TO 1290
 1240 IF(LOCAL) 1270,1270,1250
 1250 PRINT 1260
 1260 FORMAT(/11H LOCAL FLOW)
      GO TO 1290
 1270 IX=K
      J = L
      PRINT 1280
 1280 FORMAT(/20H COMBINED HYDROGRAPH)
 1290 DO 1340 M = 1,NQOMX
      QA = 0.                                                        214
      DO 1300 I=K,J
 1300 QA = QA + Q(M,I)
      Q(M,K) = QA
      IF(IUNRG) 1320,1320,1310
 1310 Q(M,L)=Q(M,L)+QA
      GO TO 1340
 1320 IF(LOCAL) 1340,1340,1330
 1330 Q(M,K) = Q(M,L)
      Q(M,L) = Q(M,L) - QA
 1340 CONTINUE
      L = K                                                          219
C                              PUNCH COMBINED HYDROGRAPH              2212
      PRINT 1350,LOCO,NQOMX,ITQO(L)
 1350 FORMAT(3H ATI5,5H  NQ=I4,I6,11H-MIN INTRVL)
      PRINT 3,(Q(M,IX),M=1,NQOMX)
 1360 ITQI = ITQO(L)
      NQI = NQOMX                                                    209
      LOCI = LOCO                                                    210
      IF (FIN) 360,360,100
      END
```

20 spaces

INPUT DATA 23-J2-L232

A. 3 Cards - Output title cards

B. Basin data card - (No decimal points for first 7 items)

1. IUNRG - Positive if job is for computing unregulated flows, leave blank normally
2. LOCAL - Positive if job is for computing local flows, leave blank normally
3. LNGTH - Duration of flood output desired, hours, cannot exceed 240 times shortest inflow interval without dimension change
4. IMNTH - Month when flood started, if historical
5. IDAY - Day " " " " "
6. IYR - Year " " " " "
7. ITIME - Time " " " " " , on 2400 time scale
8. RATIO - Ratio by which all input hydrographs will be multiplied (in addition to any value of RTIO, item C3) before routing. Assumes 1.0 if left blank.

C*. Hydrograph specification card (No decimal points for items 1, 2, and 4-7)

1. LOCI - Inflow location number (any positive integer)
2. NQI - Number of inflow values, cannot exceed LNGTH*(60)/ITQI (B3, C4)
3. ITQI - Inflow interval in minutes
4. RTIO - Ratio by which individual hydrograph will be multiplied (in addition to any value of RATIO, item B8) before routing
5. IQAVG - Positive if inflows are average for period, otherwise inflows must be instantaneous at end of period
6. IPNCH - Positive if input hydrograph is to be printed
7. NHGT - Number of hydrographs to be combined (or used to compute unregulated or local flows if item B1 or B2 is positive). Leave blank (or zero) if this hydrograph is to be routed before combining. Use -1 if another hydrograph is to be read before routing or combining.
8. FIN - Use 1 if this is last input for job, otherwise leave blank

*These hydrograph cards (C and D) to be followed by next set of hydrograph cards (C and D) if NHGT on the current hydrograph cards is negative, otherwise by next set of routing cards (E and F).

EXHIBIT 6

D*. Hydrograph cards - Flows or reservoir holdouts in cfs at end of period unless IQAVG, item C5 is positive, in which case these are average flows or holdouts for period, enough cards to contain NQI flows, item C2, 10 per card.

E#. Two data cards for each routing (No decimal points for items 1-8 and 15)

1. ITQR - Routing interval (Δt) in minutes (can equal or be an exact multiple of inflow interval)
2. ITQO - Outflow interval in minutes, must be same for all routings to same combining location, can equal or be an exact multiple of inflow interval. Must equal or exceed ITQR for straddle-stagger and Puls-lag routings.
3. NRCHS - Number of successive reaches to be routed with identical routing specification without intermediate printout (one for Tatum method and 1 or more for any other method)
4. LOCL - Outflow location number
5. NTATM - Number of routing steps for Tatum method (zero if Tatum method is not used).
6. LAG - Lag (stagger) as number of routing intervals (ITQR, item E1) for reach
7. NSTRL - Number of routing (ITQR) values (straddle) to be averaged (zero if straddle-stagger method not used), must be 2 or greater but cannot exceed 2* LAG + 2.
8. NPULS - Number of points to be read for outflow-vs-storage table (cards F) for modified Puls routing (zero if storage-lag method or reservoir routing not used). Limited to 20 points (4 cards) unless dimension changed.
9. STORA - Starting storage in acre-feet for reservoir routing, -1 if starting storage to be determined from tables (cards F) based on starting inflow, as in channel routings.
10. RES - Positive value indicates reservoir routing (by modified Puls method)
11. AMSKK - K coefficient for Muskingum routing (zero if Muskingum method not used)

*These hydrograph cards (C and D) to be followed by next set of hydrograph cards (C and D) if NHGT on the current hydrograph cards is negative, otherwise by next set of routing cards (E and F).

#These routing cards (E and F) to be followed by next set of routing cards (E and F) if NHGT on the current routing cards is positive, otherwise by next set of hydrograph cards (C and D).

12. X - X coefficient for Muskingum routing
13. QLOSS - Constant loss in cfs
14. CQLOS - Loss as ratio of remaining outflow
15. NHGT - Number of hydrographs to be combined immediately after this routing operation (zero if other hydrograph to be read before routing or combining, one if routed hydrograph is to be immediately routed further)
16. FIN - Use 1 if this is last input for run, otherwise leave blank

F#. Remaining routing cards - Storage and outflow alternately up to 20 values each (1 to 4 cards), omit if NPULS is zero or negative (E8).

STR, DISCH - Storage in acre-feet and corresponding outflow in cfs. In case of reservoir routing, minimum storage can be set by making first two items of STR equal, the first DISCH equal to zero and the second DISCH equal to the desired value for that storage.

#These routing cards (E and F) to be followed by next set of routing cards (E and F) if NHGT on the current routing cards is positive, otherwise by next set of hydrograph cards (C and D)

Note: A combining operation can be performed only one time at a station, therefore all required routings to a station must be performed before combining.