REPORT

STORM DRAINAGE SYSTEM

CITY OF CHANDLER
ARIZONA

1973

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Registered Professional Engineer (Mechanical)
CERTIFICATE NO. 2501
DONALD R. PRESSLER
Date Signed 11-9-73
ARIZONA, U.S.A.

JOHN CAROLLO ENGINEERS

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JOHN A. CAROLLO, P.E. (1906-1971)
H. HARVEY HUNT, P.E.
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GAIL P. LYNCH, P.E.

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AREA CODE: (602) 248-0400

November 21, 1973

Honorable Mayor and Council
City of Chandler
200 East Commonwealth Avenue
Chandler, Arizona 85224

Gentlemen:

Submitted herewith is our Report on a storm drainage system for the City of Chandler prepared in accord with the terms of our Agreement dated April 19, 1973. Our summary and recommendations are presented in Section 2.

We do appreciate the help and cooperation of your City of Chandler Staff. We will be pleased to confer with the Council and Staff in preparation to implement those recommendations which you select and support.

Very truly yours,

JOHN CAROLLO ENGINEERS

Donald R. Preisler

Donald R. Preisler, Partner
Arizona Registration No. 2501

John H. Shannon

John H. Shannon, Engineer
Arizona Registration No. 2930

DRP/rmh

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ARIZONA

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Section 1

PURPOSE AND SCOPE

The purpose of this study and Report is to consider the elements relating to storm drainage in the Report Area and prepare alternate ten-year capital improvement programs for storm drainage.

The scope of this study includes eight elements:

1. A population distribution projection with corresponding land use patterns.

2. Definition of drainage sub-basins comprising the Chandler Report Area.

3. Description of the existing storm drain system elements.

4. An analysis of hydrology data applicable to the Chandler Report Area.

5. An estimate of runoff rates to be considered in planning elements of alternate storm drain systems.

6. Concepts for alternate storm drain systems required with selected alternate rainfall frequencies and effects of detention and retention basins and ponds.

7. Estimated costs of alternate systems to be considered in a ten-year capital improvement program.

8. Consider a Grading and Drainage Ordinance to implement a requirement to pond rainfall on private property.

Section 2

SUMMARY AND RECOMMENDATIONS

SUMMARY

Flood protection for the Chandler Report Area is a part of the Maricopa County Flood Control District program. This program is now under study, is in preliminary form, and is not expected to provide Floodways in this Report Area during the ten-year program developed in this study for the City of Chandler. Natural drainageways and Salt River Valley Water Users Association drainage ditches and canals do not have adequate capacities to receive runoff from this Report Area. It is concluded that retention ponds and deeper basins will be required for disposal of stormwater runoff by percolation.

Two alternate plans were prepared for Sub-Basins of this Report Area. They are coordinated with Arizona State Highway Department preliminary plans for storm drains along Arizona Avenue and Williams Field Road. These programs are independent of floodway construction schedules but compatible with preliminary floodway route and depth planning.

Alternate Plan I includes retention of rainfall inside property lines as a landowner responsibility. Runoff from public rights-of-way would be collected from each one hundred sixty acre tract and ponded for controlled but complete release to storm drains. Storm drains in each Sub-Basin would discharge to a retention basin for disposal by percolation into the ground. The basis of design is rainfall intensity equal to one-half of the intensity expected to recur once each year.

Alternate Plan 2 is based upon the same system except that one-half of the runoff to each pond is retained and the release rate is less to the storm drain. Therefore Plan 2 has smaller pipe sizes and a smaller retention basin.

Estimated cost of each alternate plan includes land, construction, and incidental costs. At the 1974 cost index of construction, estimated costs are:

Alternate Plan 1	$5,855,000
Alternate Plan 2	$5,295,000

RECOMMENDATIONS

It is recommended that the City of Chandler:

1. Cooperate with Maricopa County Flood Control District planning.
2. Cooperate with the Arizona State Highway Department program.
3. Adopt Alternate Plan 2 for implementation.
4. Prepare a street grading ordinance to supplement implementation of Plan 2. (See Appendix B.)
5. Establish legal control of storm water retention within property lines or a functionally equivalent retention.
6. Acquire land sites for ponds and basins.
7. Fund Plan 2.
8. Construct Sub-Basin 1 plan in ten-year program.
9. Promote implementation of Sub-Basin 3 plan by subdividers until City authority is established.
10. Implement Sub-Basins 2 and 4 surface drain schedules as needed.

Section 3

REPORT AREA

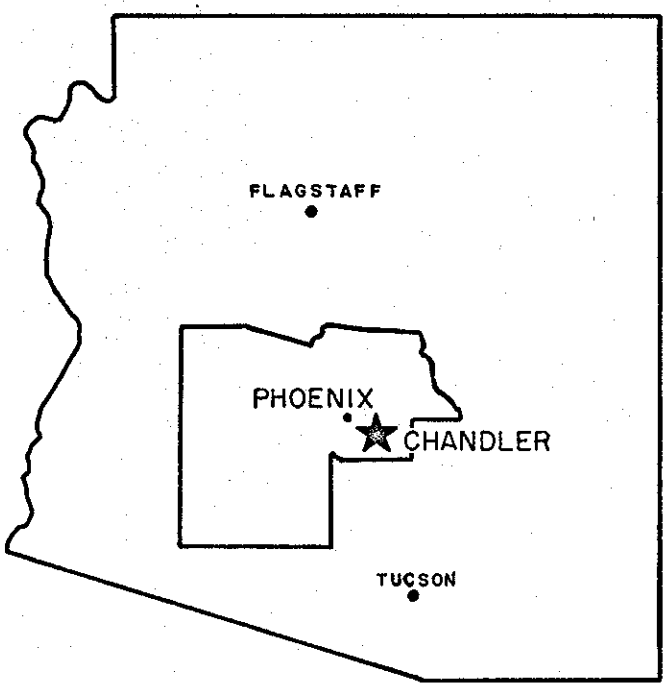
The incorporated City of Chandler is located centrally in the State of Arizona and southeast of the Phoenix metropolitan area in Maricopa County. The location of Chandler relative to other cities in Arizona and Maricopa County is illustrated on Plate 1.

The Report Area contains 46 square miles of land principally in agricultural use except for five to six square miles occupied by County subdivisions and the City of Chandler. The Report Area boundary drawn on Plate 2 encompasses the present City Limits of Chandler, lands east from Interstate 10 to Cooper Road, south to Germann Road and north to the agreed upon boundaries with Tempe and Mesa. The ten-year projected urban growth to about eleven square miles has been outlined graphically around the City and at locations adjacent to Tempe and along Williams Field Road near Interstate 10. Queries of interest in City services have come from land developers north, east, west and south of Chandler.

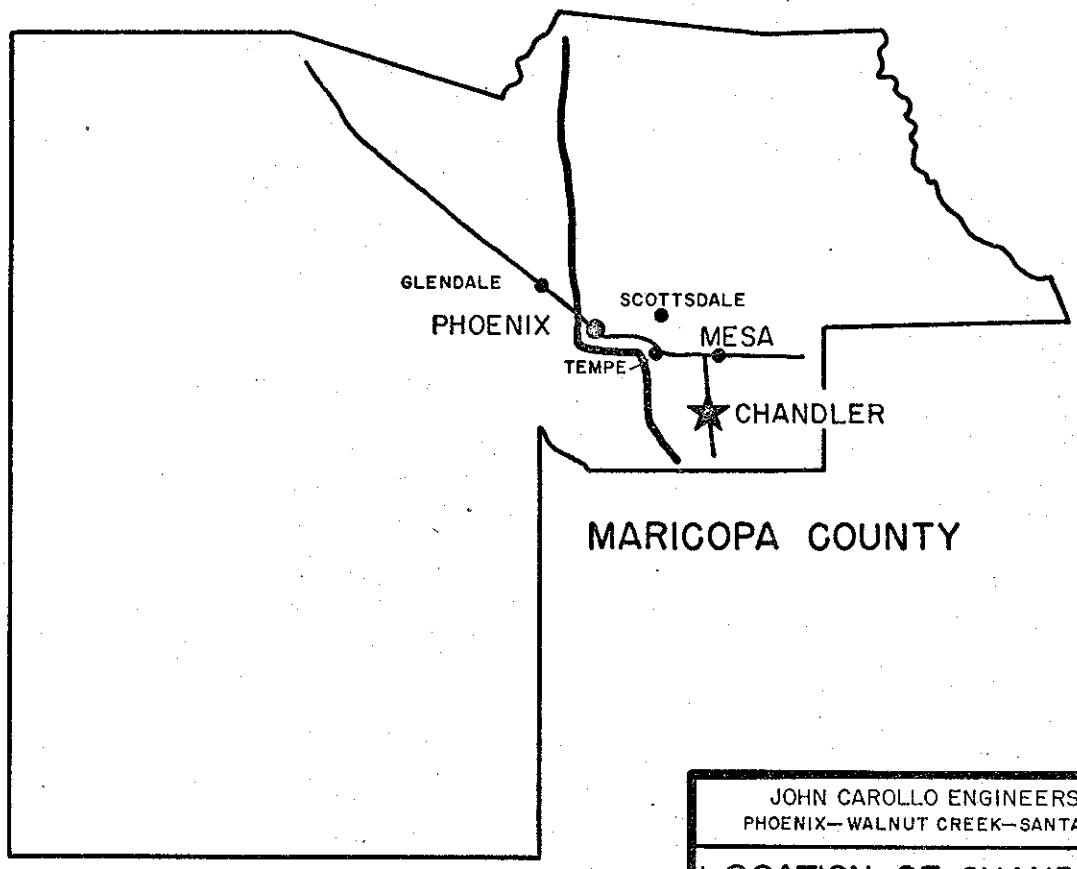
The land surface slopes moderately to the west and south except for the sector west of the Gila Drain which slopes to the east and south into the Gila Drain. Slopes vary between one and two feet per thousand with contours running primarily parallel in north and south direction. Prior to development, the Report Area drained in sheet flow west-southwest to the Gila River.

The Report Area is crossed in a north-south direction by State Routes 87 and 93 through Chandler and by Interstate 10 on the west. Williams Field Road designated FAS 236 is the prime east-west artery conveying traffic to Williams Air Force Base east of Chandler. County roads at one-mile intervals comprise the network of roadways serving the area. Southern Pacific Transportation

VICINITY MAPS



STATE OF ARIZONA



MARICOPA COUNTY

JOHN CAROLLO ENGINEERS
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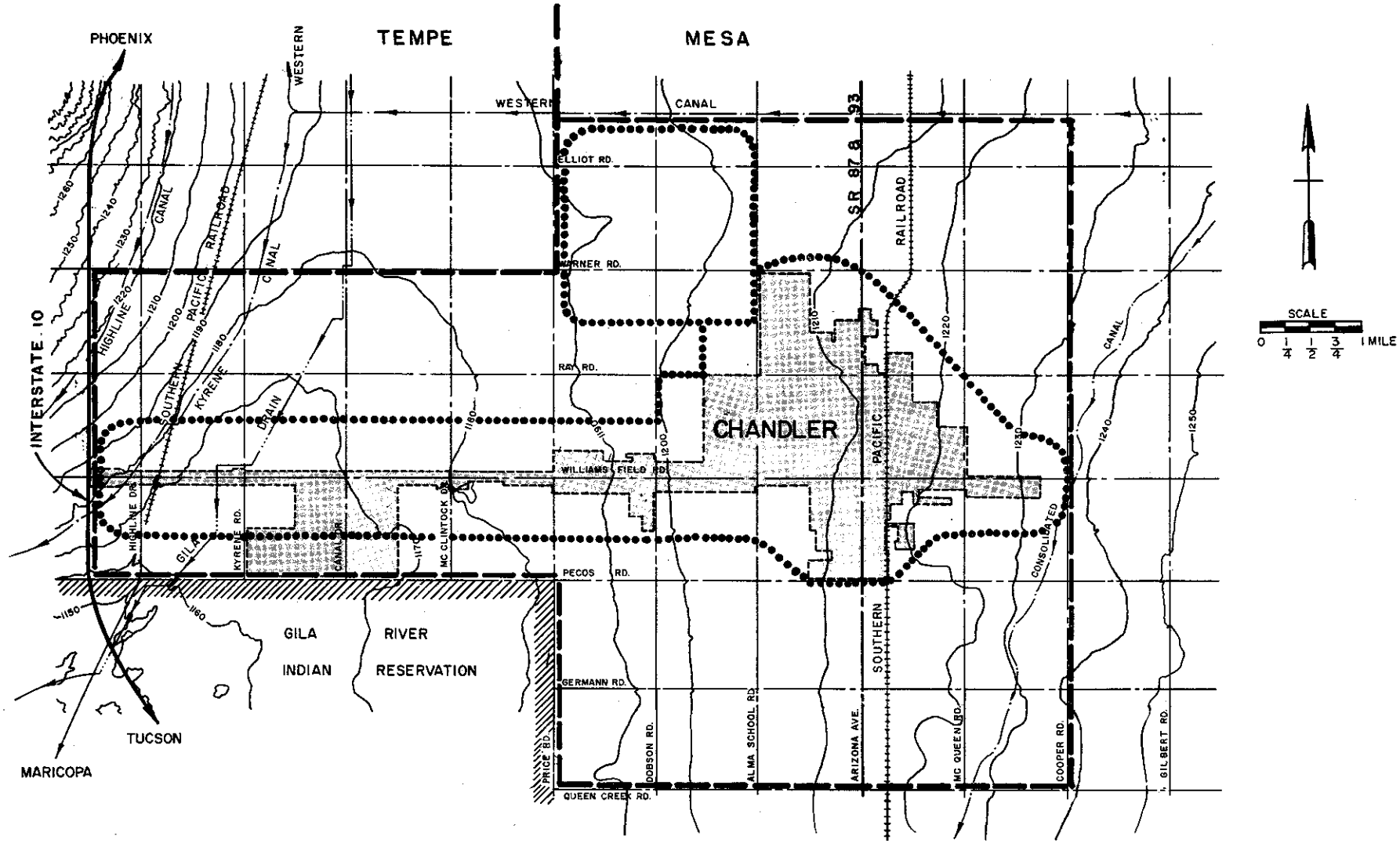
LOCATION OF CHANDLER

PLATE 1



CHANDLER
REPORT AREA
PLATE 2

Company serves the area from two railroad tracks parallel with the earlier mentioned north-south highways. The Salt River Valley Water Users Association (SRVWUA) delivers irrigation water and recovers wastewater throughout the Report Area by means of a canal, conduit, and drainage ditch system. El Paso Natural Gas Company transmission pipeline, and American Telephone & Telegraph phone lines and coaxial cable cross the area west of Chandler.

Section 4

POPULATION PROJECTION

Storm drain systems planned in this study are intended to serve urbanizing areas in the Chandler planning area. Land use patterns were established to contain the population distribution for which water and sewerage programs were planned in the 1972 study. Other assumptions could be made but this concept does produce water, sewer, and storm drain system plans which are correlated in service areas and in time periods.

Table 1 has listed the census record for the increasing City Limits from 1930 through 1970. The 1973 estimated population in the Report Area for this study is 20,000. Estimated average annual population growth rates increase from 1,500 to 4,900. Fifty-four thousand persons are to be provided for by 1985. These factors are plotted on Plate 3.

Urbanizing areas can be defined for general location by 1985 from the schematic indications on Plate 2. Four drainage areas indicated on Plate 4 are designated sub-basins. These areas are adequate to contain the year 2000 population projections and provide a basis for selecting routes and scheduling storm drain facilities to serve the projected population growth and distribution.

Storm drain routes scheduled in the 1975-1985 period are limited to the projected 1985 urban area but with capacities for the urban area projected for the year 2000.

Table 1

STORM DRAIN REPORT AREA POPULATION PROJECTIONS

POPULATION DISTRIBUTIONS TO PROJECTED URBANIZED SUB-BASINS (Population in thousands)

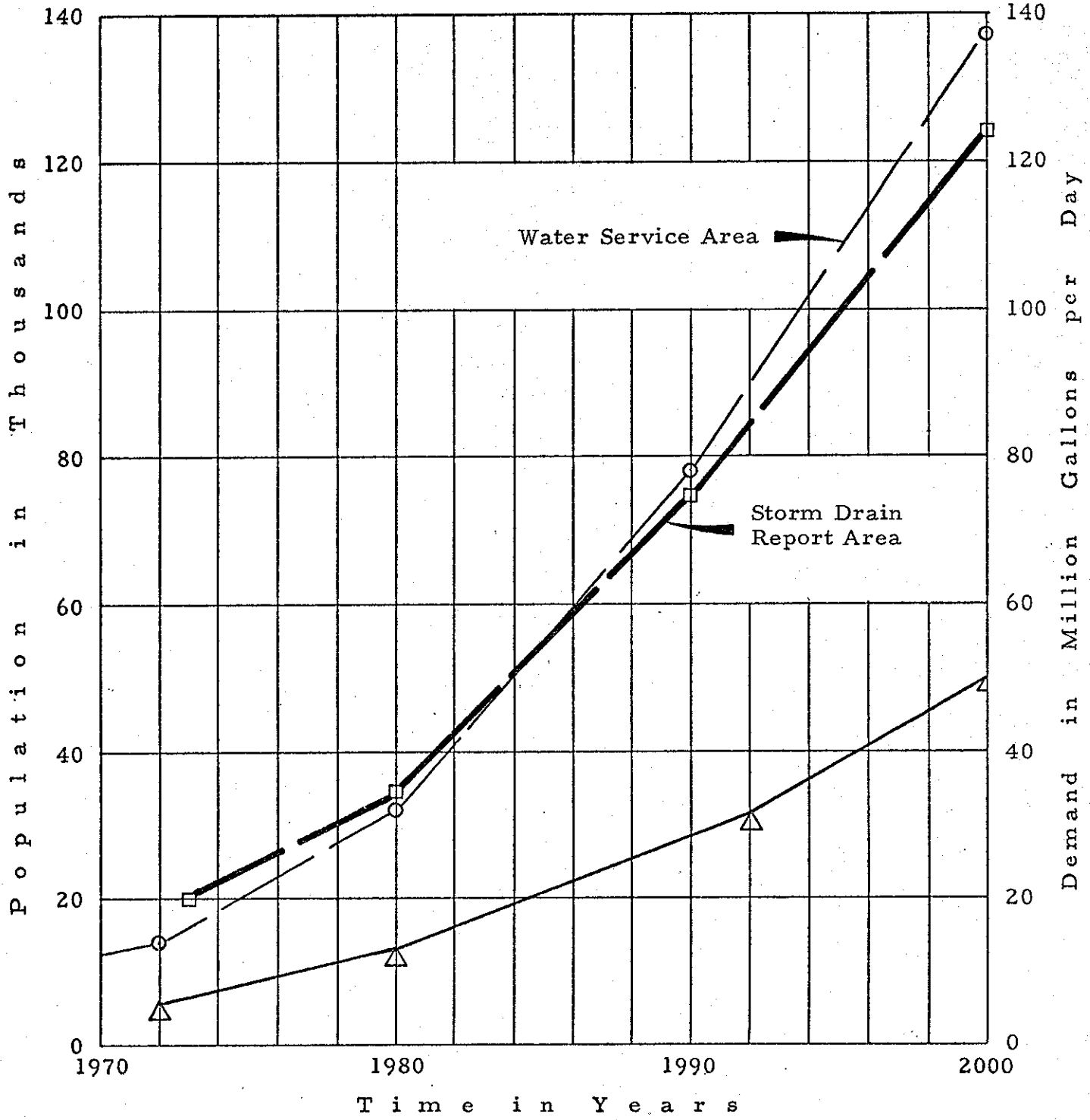
Year	Census Record City Limits	Projection this Report Area	Average Annual Increase 1,000's	Total Square Miles	SB-1 Central Pop.	SB-1 Central Sq Mi	SB-2 West Pop.	SB-2 West Sq Mi	SB-3 North Pop.	SB-3 North Sq Mi	SB-4 Highline Pop.	SB-4 Highline Sq Mi
1930	1,378											
1940	1,239											
1950	3,799											
1960	9,531											
1965	12,181											
1970	13,763											
1973		20,000		*	15	*	2	*	2	*	1	*
			1.5									
1975		23,000		4.6	16	3.2	2	0.4	4	0.8	1	0.2
			2.2									
1980		34,000		7.8	21	4.2	3	0.6	8	1.6	2	0.4
			4.0									
1985		54,000		10.8	27	5.4	8	1.6	14	2.8	5	1.0
			4.2									
1990		75,000		15.0	35	7.0	12	2.4	20	4.0	8	1.6
			4.9									
2000		124,000		24.8	44	8.8	22	4.4	40	8.0	18	3.6

* Existing townsite not at 5,000 persons per square mile.
Projected average densities at 5,000 persons per square mile.

Distributions correlated with
1972 Water and Sewerage Report distributions.

PROJECTED CHANDLER POPULATION GROWTH RATES

STORM DRAIN REPORT AREA



Projected Population Growth — Water Service Area

Projected Maximum Day Water Demand

Projected Population Growth — Storm Drain Report Area

PLATE 3

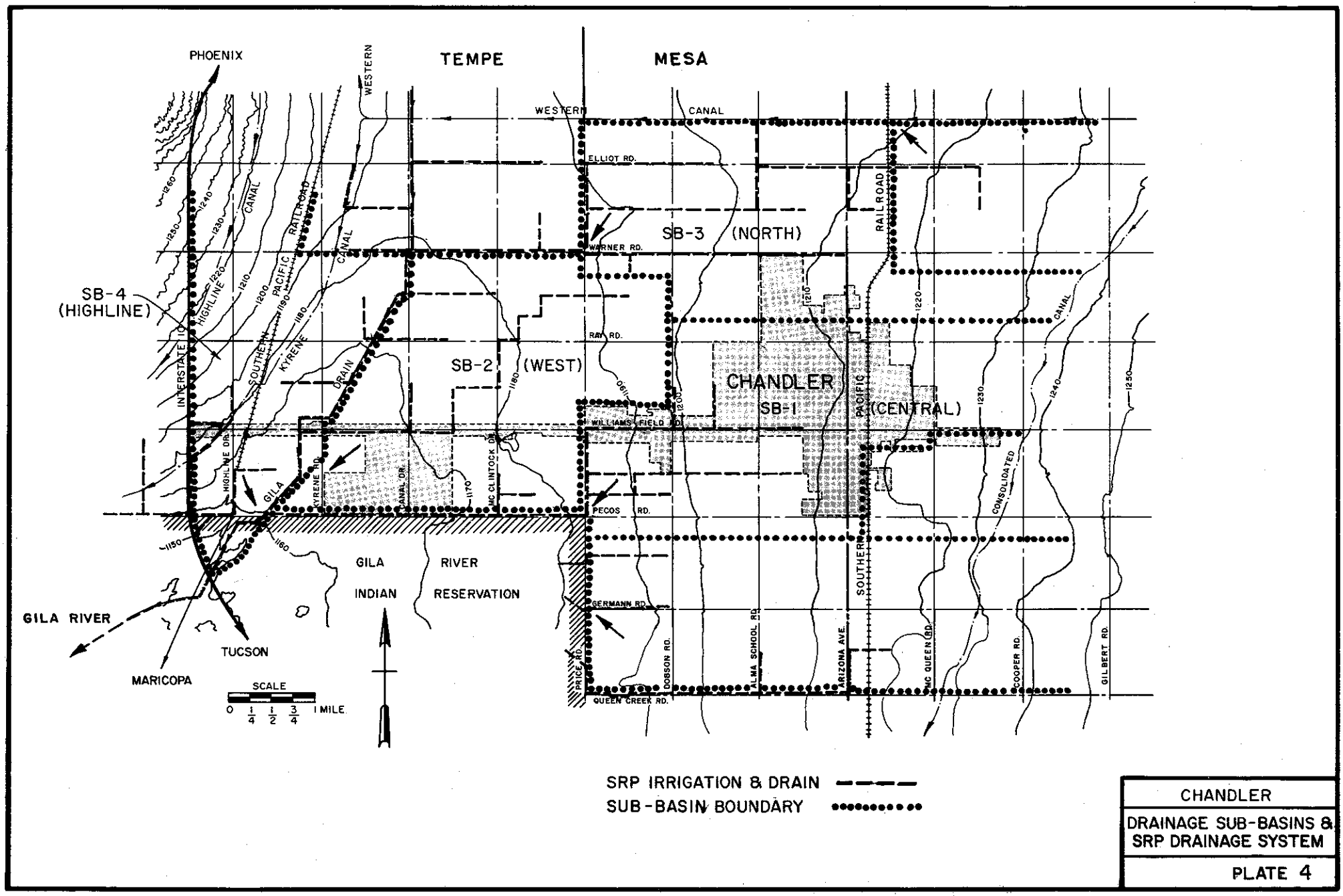
Section 5

EXISTING STORM DRAIN FACILITIES

The banks of the Western and Consolidated Canals prevent surface flow of storm water into the Report Area from the north and east. Rainfall south and west of these canals is prevented from sheet flow across the area by irrigation and drainage canals, field furrows and borders, roads and railroad embankments. Irrigation delivery channels are generally slip-form concrete ditches with water surfaces higher than adjacent ground. Drainage channels are generally unlined ditches with banks at the same level as adjacent ground and water surfaces lower than adjacent ground. Delivery and drain channels are buried pipe through developed urban areas.

Existing Salt River Project irrigation supply and wastewater ditches, which comprise a surface drainage system southwestward to the Gila Drain, are indicated on Plate 4. Also shown is the subdivision of the Report Area into surface drainage areas with arrows designating the general points of concentration. Existing conditions in Chandler are indicated on Plate 5.

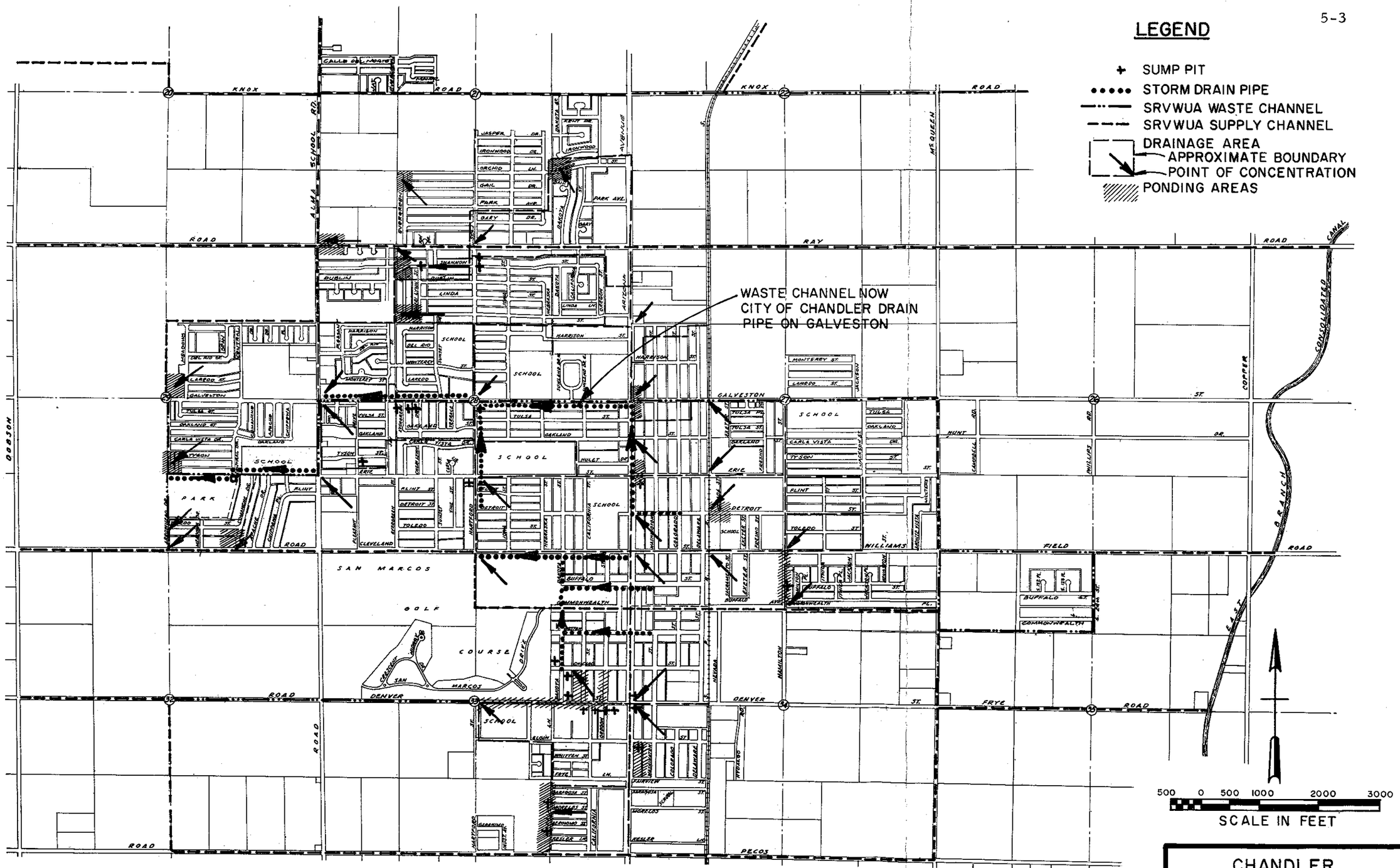
Storm water collected in roadside gutters and storm drains is disposed of in sump pits or released into Salt River Project ditches. The 24-inch storm drain on Williams Field Road which flows westerly from Arizona Avenue with catch basins at intersecting streets drains into the Salt River Project system at Hartford Street. The Williams Field Road storm drain receives the flow from the 15-inch Dakota Street storm drain which begins at Chicago Street and collects west flowing drains on Buffalo and Boston Streets originating east of Arizona Avenue. A catch basin at Oakland Street and Pleasant Drive is drained by a storm sewer flowing north to Galveston



CHANDLER

DRAINAGE SUB-BASINS & SRP DRAINAGE SYSTEM

PLATE 4



CHANDLER

EXISTING CONDITIONS

PLATE 5

Street. A catch basin at Erie Street and Alma School Road is drained to the west. Surface inlets on Detroit Street and Arizona Avenue drain westward into the school yard. On Galveston Street the irrigation ditch from east of the Southern Pacific railroad has been tiled with 12-inch pipe to Arizona Avenue, 16-inch pipe to Hartford Street and 24-inch pipe to Alma School Road. Flow is carried south in a drainage ditch on Alma School Road to an inlet box and drain at Erie Street which conveys flow west to a waste ditch on Arrowhead Drive draining south to the irrigation lateral on Williams Field Road. Along Williams Field Road, Denver Street, and other alignments, there are surface inlets into Salt River Project channels.

For low spots not drained adequately by street gutters, sump pits have been built that are 4 feet in diameter, 45 to 60 feet in depth, masonry domed and equipped with a surface inlet. The sump pits are reported to seal up with silt accumulation and become ineffective.

Historically the City of Chandler has experienced storm water ponding in the streets annually at twelve locations. These problem areas have been indicated on Plate 5 along with the location of improvements consisting of sump pits and storm drains.

Areas of storm water ponding are stated to be of such depth as to impede vehicular traffic several times a year when there is rainfall of one-half 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 are reported to be negligible.

Section 6

PROPOSED FLOODWAYS

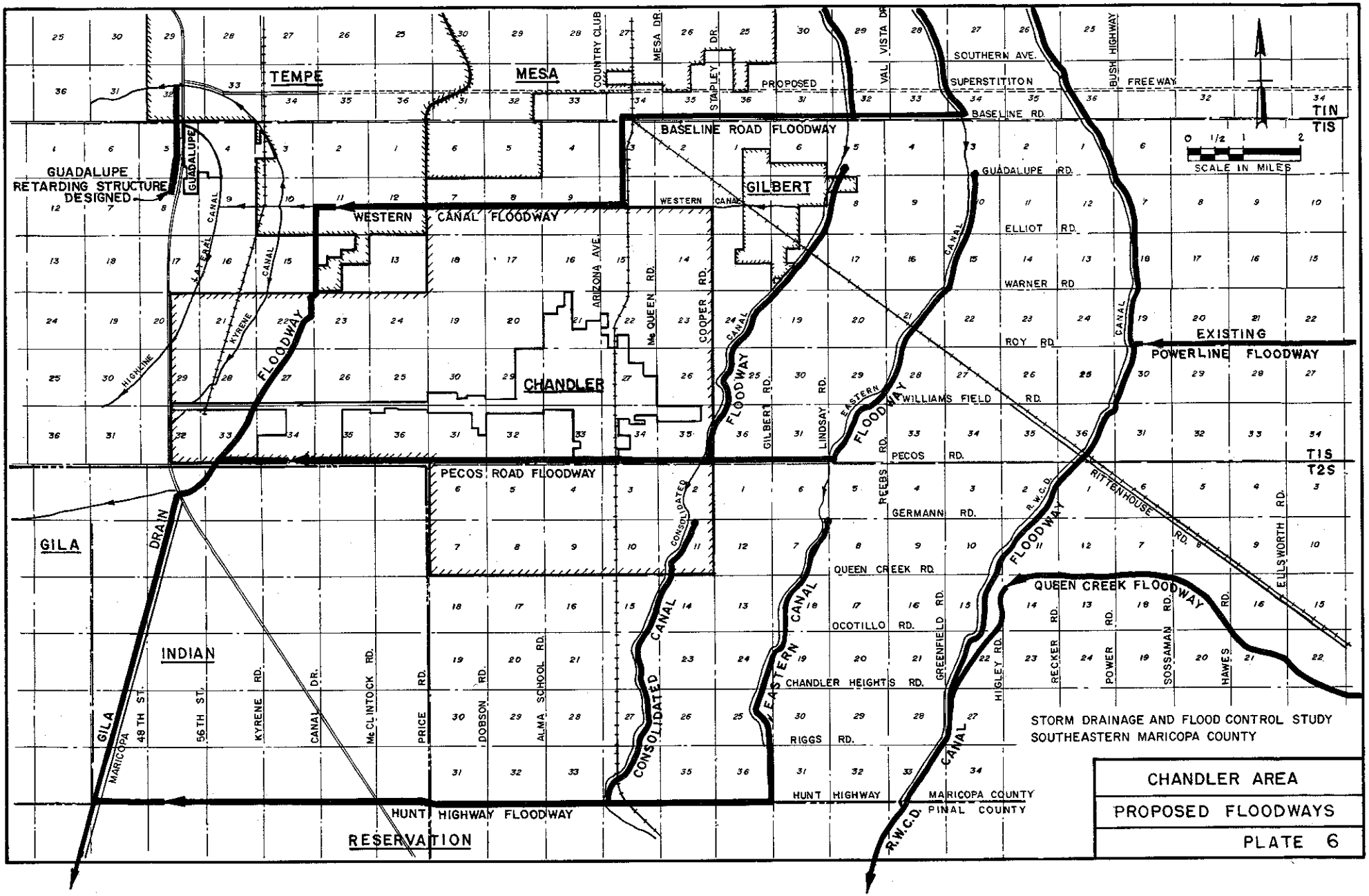
Two reports have been prepared proposing the construction of Gila Drain Floodway and tributary floodways for the southeastern portion of Maricopa County. These reports are:

> Comprehensive Flood Control Program Report - 1963, Maricopa County Flood Control District
>
> Storm Drainage Flood Control Study, Southeastern Maricopa County - 1973, Boyle Engineering Corporation and L. H. Bell and Associates

The 1973 report outlines a comprehensive plan for floodways of which Gila Drain Floodway, Pecos Road Floodway, and Western Canal Floodway are future outlets for a City of Chandler storm drain system. Construction of these floodways is not expected in the near future.

Locations of proposed floodways in southeast Maricopa County relative to the City of Chandler are reproduced from the County report as Plate 6.

Maricopa County is the agency designated to finance floodway right-of-way acquisition and relocation of utilities in preparation for construction of floodways by the United States Corps of Engineers. Investigation of Gila Drain Floodway by the Corps of Engineers has been requested by Maricopa County. A one hundred-year frequency storm is a basic design requirement to obtain Federal funds for construction. Cost to a local government agency participating in a Federal Assistance Project amounts to about twenty-five percent of total project costs.


TEMPE
MESA
GILBERT
CHANDLER
GILA
INDIAN
RESERVATION
GUADALUPE RETARDING STRUCTURE DESIGNED
BASELINE ROAD FLOODWAY
WESTERN CANAL FLOODWAY
PECOS ROAD FLOODWAY
HUNT HIGHWAY FLOODWAY
EXISTING POWERLINE FLOODWAY
QUEEN CREEK FLOODWAY
EASTERN FLOODWAY
CONSOLIDATED CANAL
EASTERN CANAL
R.W.C.D. CANAL
GILA RIVER DRAIN
SOUTHERN AVE.
SUPERSTITION FREEWAY
PROPOSED
BASELINE RD.
GUADALUPE RD.
ELLIOT RD.
WARNER RD.
ROY RD.
WILLIAMS FIELD RD.
PECOS RD.
GERMANN RD.
QUEEN CREEK RD.
OCOTILLO RD.
CHANDLER HEIGHTS RD.
RIGGS RD.
HUNT HIGHWAY
MARICOPA COUNTY
PINAL COUNTY
SCALE IN MILES
0 1/2 1 2
T1N
T1S
T2S
STORM DRAINAGE AND FLOOD CONTROL STUDY
SOUTHEASTERN MARICOPA COUNTY
CHANDLER AREA
PROPOSED FLOODWAYS
PLATE 6

Section 7

HYDROLOGIC DATA

Precipitation is the index available for computing the quantity of storm water and runoff for various return periods from the urban areas of Chandler. U.S. Weather Bureau rainfall data has been analyzed. The relation of rainfall to return period presented in Weather Bureau Technical Paper No. 40 has been reviewed. For this study the Arizona Highway Department, Bridge Division Publication, "Hydrologic Design for Highway Drainage in Arizona," has been used as a reference. Precipitation Maps prepared by the U.S. Weather Bureau for the Soil Conservation Service and revised for the Arizona Highway Department provide the basis of return period rainfall quantities. Precipitation Maps are included in the Appendix at the two-year frequency for the six- and twenty-four hour rainfall duration. Utilizing the Arizona Highway Department rainfall depth-duration diagram, also in the Appendix, rainfall depths for one-, two-, and three-hour storm duration were estimated. Rainfall depths for thirty-minute duration were obtained from Technical Paper No. 40. Table 2 presents estimated precipitation in the Chandler area for a wide range of storm durations and return periods. Plate 7 is a graphical presentation of the Chandler return period rainfall data.

Table 2

CHANDLER AREA PRECIPITATION - INCHES

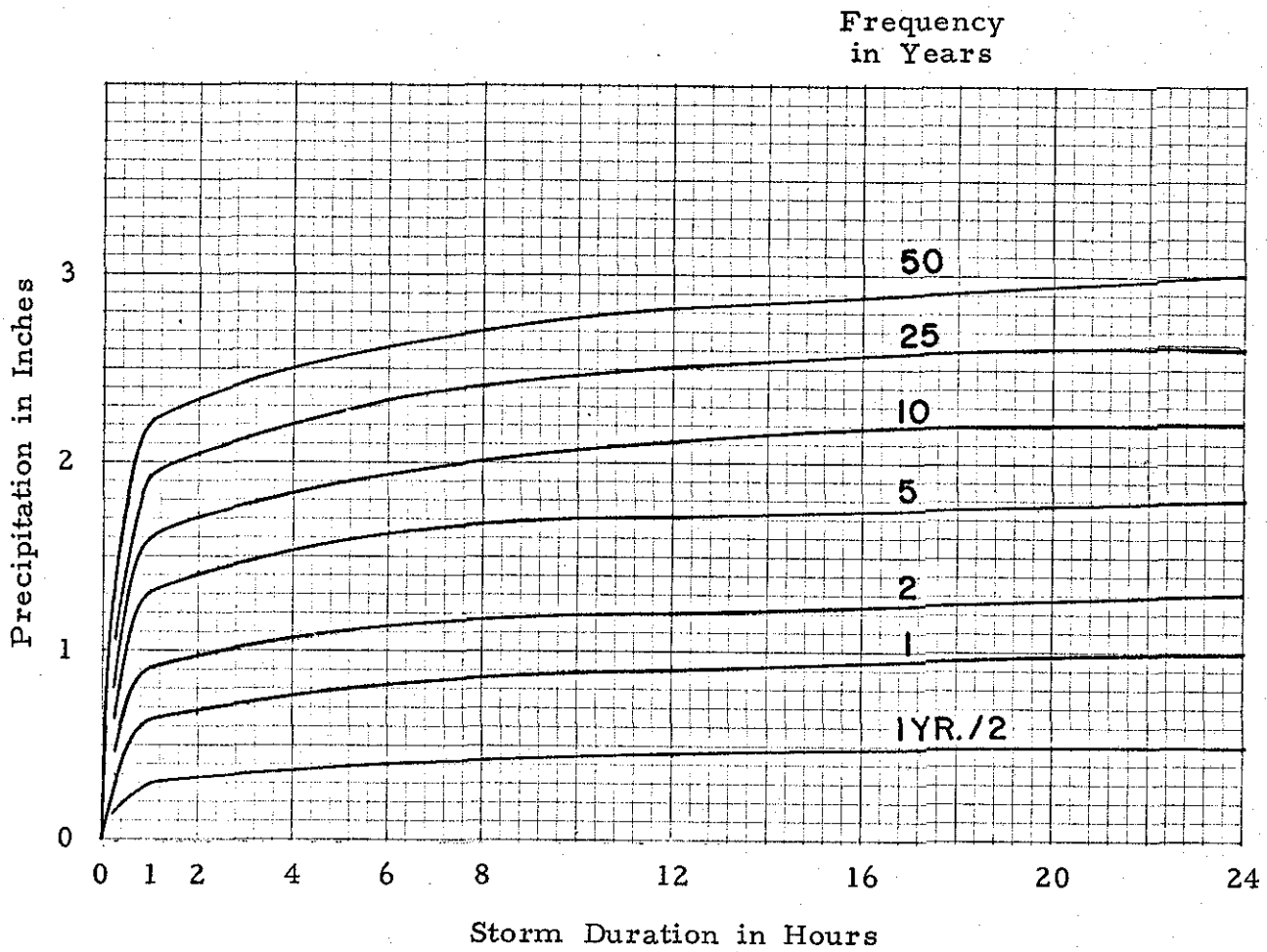
Station: Chandler, Arizona
Latitude: 33° 18'

Longitude: 110° 50'
Elevation: 1,215

Rainfall Duration	Frequency - Years							
	1 yr/2	1	2	5	10	25	50	100
5 min	0.09	0.18	0.26	0.38	0.46	0.55	0.64	0.74
10 min	0.13	0.27	0.41	0.58	0.72	0.85	0.99	1.17
15 min	0.17	0.34	0.51	0.74	0.91	1.08	1.25	1.48
30 min	0.23	0.46	0.70	1.02	1.26	1.50	1.74	2.05
1 hr	0.30	0.60	0.90	1.30	1.60	1.90	2.20	2.60
2 hrs	0.33	0.65	0.95	1.40	1.70	2.00	2.30	2.70
3 hrs	0.35	0.70	1.00	1.45	1.75	2.10	2.40	2.80
6 hrs	0.40	0.80	1.10	1.60	1.90	2.30	2.60	3.00
12 hrs	0.45	0.90	1.20	1.70	2.10	2.50	2.80	3.20
24 hrs	0.50	1.00	1.30	1.80	2.20	2.60	3.00	3.40

References: Arizona Highway Department Precipitation Maps, 1970 Revision (S.C.S. - U. S. Weather Bureau)

U. S. Weather Bureau Technical Paper No. 40



FREQUENCY-PRECIPITATION CURVES

FOR

CHANDLER, ARIZONA

Plotted from Table 2

Section 8

STORM DRAIN ANALYSIS

The rational method has been used to estimate runoff quantities. This method translates rainfall into runoff by the formula Q = CiA in which A is the drainage area in acres tributary to the point under design; i is the average rainfall intensity, in inches per hour, for the period of maximum rainfall of a given frequency of occurrence having a duration equal to the time required for the runoff originating during said period of maximum rainfall to flow from the remotest part of the drainage area to the point under design; C is a runoff coefficient or factor which is the ratio between the maximum rate of runoff from the area and the average rate of rainfall on the area during the time of concentration; and Q is the maximum rate of runoff expressed as cubic feet per second when A and i are expressed in acres and inches per hour, respectively.

Runoff factors (C) for some typical land uses drawn from the Arizona Highway Department Hydrology Design Manual are as follows:

Chandler Zoning	Arizona Highway Department Land Use	Runoff Factor - C
R-1 to R-3	Residential	0.35
R-3	Multi-Family	0.50
R-4	Apartment	0.60
R-5	Mobile Home	0.60
C-1 to C-3	Commercial	0.70
I-1 to I-3	Industrial	0.60
Public	School, Park, Cemetery	0.10
Public	Streets	0.90
Public	Gravel Roadway	0.50

For a typical urban square mile a composite runoff factor C of 0.50 was determined and used in typical computations to determine flow (Q) and pipe size.

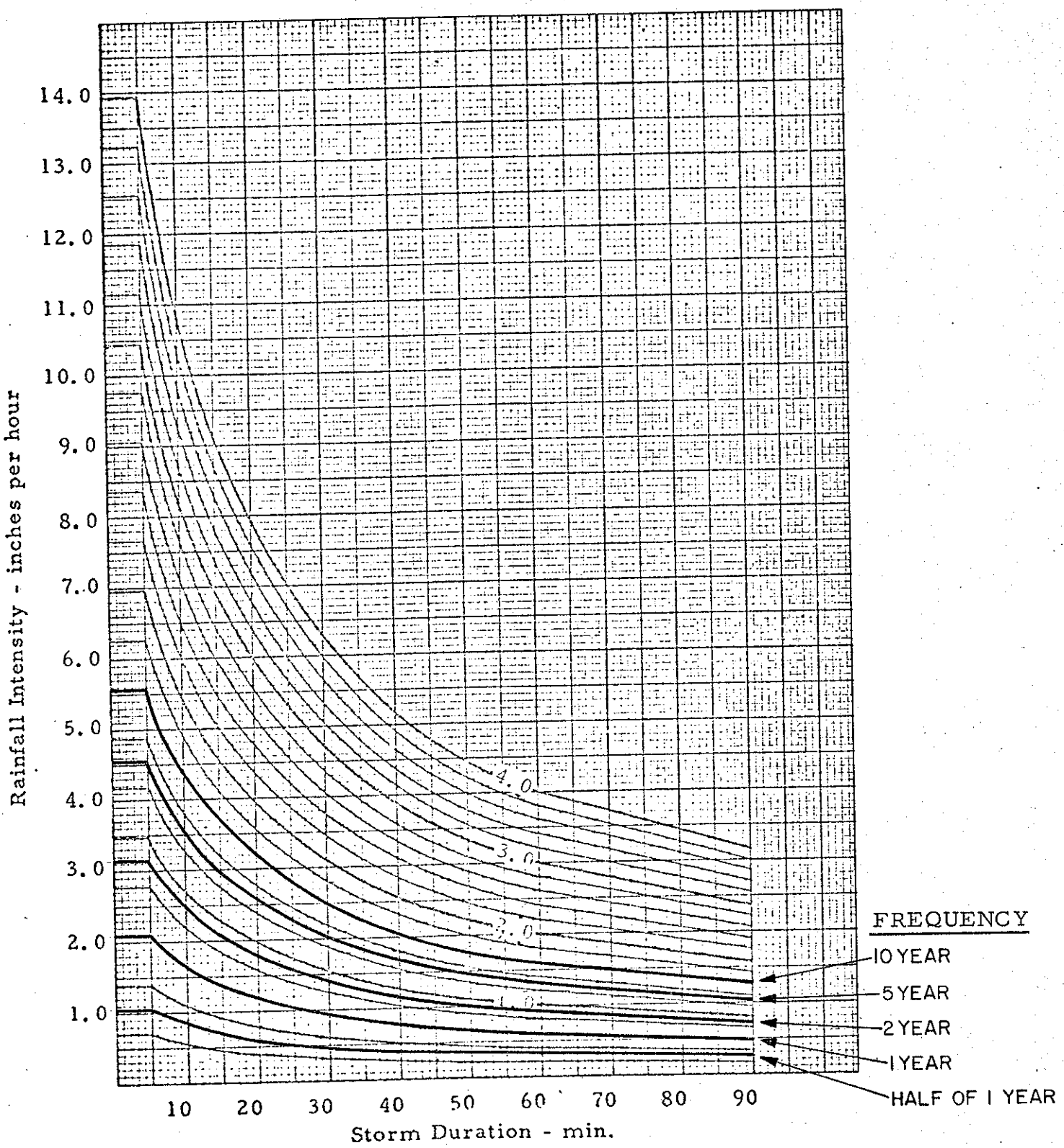
Rainfall intensity-duration curves were developed in accordance with Arizona Highway Department standard design method and with the U. S. Weather Bureau Technical Paper No. 40. On Plate 8 the half of one-year, one-, two-, five- and ten-year rainfall intensity duration curves are presented indicating the decrease of intensity with duration of storm.

The return frequencies for this Report are two-year, one-year and half the one-year design storms. Arizona State Highway and Federal Aid Highway Standards require a ten-year return frequency level of storm drain capacity unless a lesser degree is requested prior to design and the community has a limited amount of funds.

An initial drainage area of 40 acres (typical subdivision) was established at the high end of the drainage sector. In the general case the initial area is assumed to be a developed area with subdivision streets conducting storm water to the first inlet. The time of concentration for this analysis has been assumed to be thirty minutes.

A value for large pipe of 0.010 for "n" has been used in the solution of Mannings Formula for flow (Q) and size of pipe required.

Typical and specific flow computations and pipe size determinations were made in order to prepare drainage system maps of various frequency.



RAINFALL INTENSITY - DURATION CURVES

Arizona Highway Department
Hydrologic Design and
Revised Precipitation Maps

Weather Bureau
Technical Paper No. 40

PLATE 8

Section 9

STORM DRAIN SYSTEM CONCEPTS

Rainfall at Chandler normally increases quickly in intensity to a peak rate in about twenty minutes then slows to a lesser steady or intermittent pattern. This sequence is demonstrated graphically on Plate 7, page 7-3. A typical forty-acre tract drains to the lowest corner in about thirty minutes. The unrestricted peak flow rate from that tract will occur about fifty minutes after rainfall begins.

Existing street gutter gradients are small, providing less energy than required for rapid runoff. As depth of flow increases, ponding spreads and inconvenience for drivers and pedestrians increases. After rainfall ceases, runoff continues to lag for lack of more slope and energy. After runoff ceases, isolated ponds remain in low areas. Percolation and evaporation finally dispose of ponded water.

New tracts are projected for development in areas generally providing no more slope than on existing streets. Similar conditions will be created in these new tracts unless adequate controls are developed in time to minimize the typical drainage system deficiencies.

A degree of protection can be selected as a goal in system design. Protection can be achieved from property damage and from public inconvenience. Protection of life will be a design consideration where deep basin ponding and pumping machinery are elements in the program.

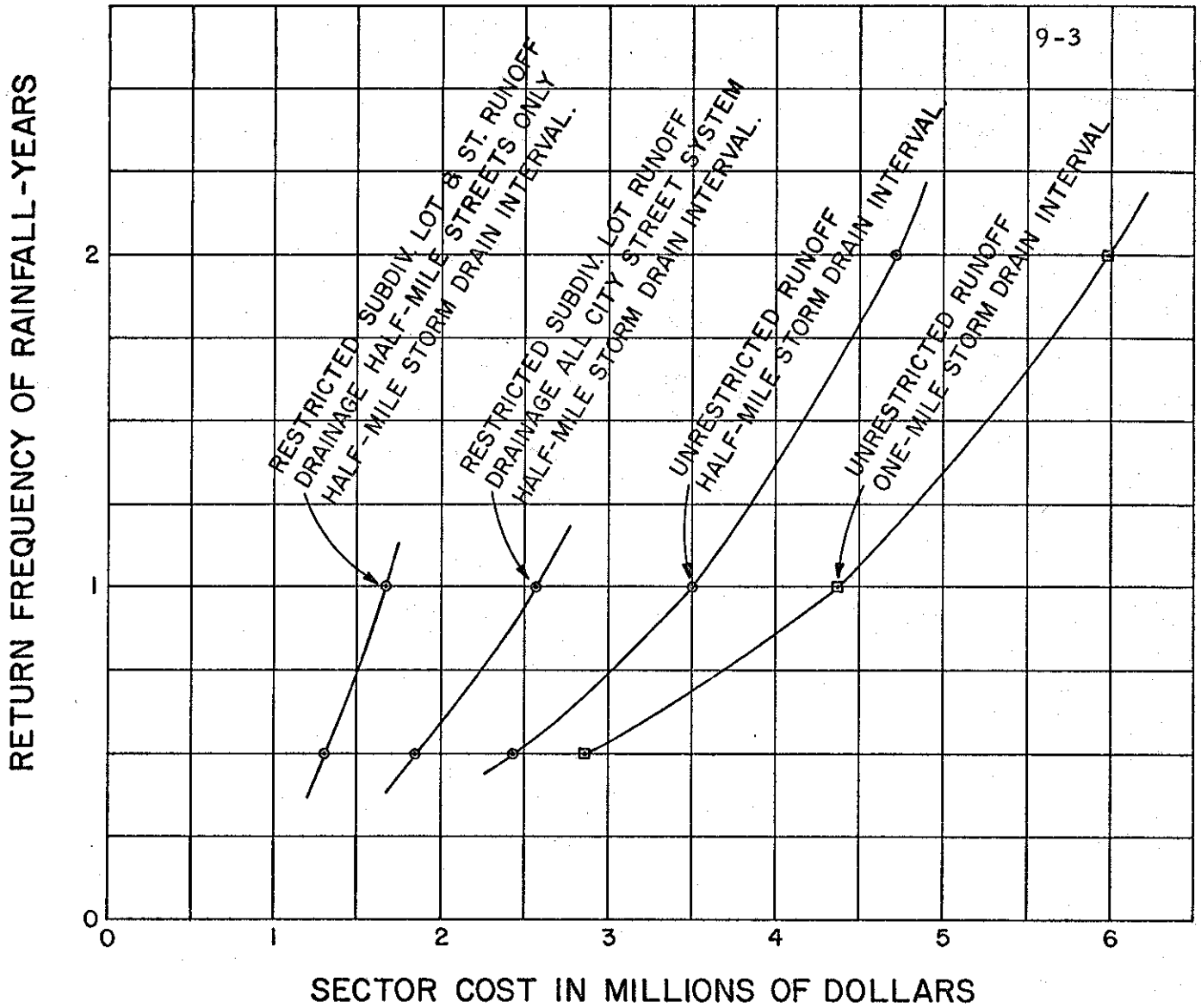
Coordination in planning will be beneficial where more than one agency is responsible for establishing parts of a system. Parts will be established by the Salt River Water Users Association, subdividers, the Maricopa County Flood Control District, the U.S. Corps of Engineers, the

Maricopa County Highway Department, the Arizona State Highway Department, and the City of Chandler. The time of completion for floodways will be especially significant.

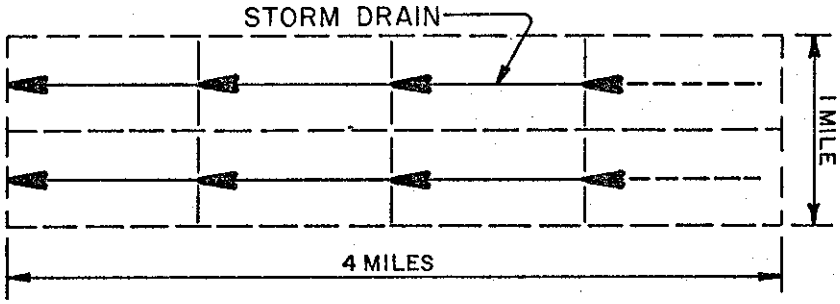
Means for minimizing runoff peak flow rates includes retention and percolation where rain falls, detention by ponding and controlled rate of release to the collection system, and discharge from collection systems to detention basins with controlled rate of release to subsoil percolation, irrigation channels, or floodways. Percolation from deep basins to the groundwater table is foreseen as beneficial in the same ways as natural percolation has been beneficial.

A general analysis was made of four systems adequate for rainfall return periods of two-year, one-year, or one-half of one-year. A typical four-square-mile simulated sector was the area contributing flow in each case. The typical sector is one mile wide and four miles long as indicated on Plate 9 and does not include means for disposal in basins or floodways.

Unrestricted runoff to a one-mile storm drain interval is the most costly of the four systems and is, in concept, too simple. Unrestricted runoff to a half-mile storm drain interval is the second most costly. By restricting runoff from lots and draining streets to storm drains at half-mile intervals, cost can be reduced another increment. The least costly of four systems considered would restrict runoff from lots and collect street runoff for detention in one pond for each one hundred sixty-acre tract. Controlled release would minimize peak flow rates to storm drains.



ALTERNATE DRAINAGE SYSTEMS COST VS RAINFALL FREQUENCY
ONE- X FOUR-MILE SECTOR, CHANDLER, ARIZONA



TYPICAL SECTOR

The graph on Plate 9 indicates estimated costs of typical sector facilities for a one-year return period rainfall:

$4.4 million	Unrestricted runoff	One-mile interval
$3.5 million	Unrestricted runoff	Half-mile interval
$2.6 million	Restricted lot runoff	Half-mile interval
$1.7 million	Restricted street and lot	Half-mile interval

The two-year frequency rainfall criteria would require about $1 million dollars additional expenditure as compared to the one-year frequency rainfall.

The half of one-year frequency rainfall criteria would require between $1 million and $3 million depending upon the runoff control established.

These alternate systems would serve an area of four square miles and a population of about 20,000 people. The 1985 projected population, 54,000, and projected urban area, 10.8 square miles, would require the equivalent of about 2.5 of these sector systems with separate disposal facilities for each.

It is concluded that natural terrain and rainfall in the Report Area produced sheet flow of runoff without cutting channels larger than those readily adapted to existing irrigation system drainage channels. Most of the land has been improved for flood irrigation and therefore retains rainfall on fields.

Urban areas tend to promote progressively increasing runoff rates by making more impervious those surfaces improved as roofs, slabs, and pavement. As the density of urban development increases, less unplanned ponding remains. It is fundamental to a feasible storm drainage program for

Chandler that adequate ponding areas be provided in the present urban area and in all new urban areas.

Administration and enforcement authority is not now established to permit control by Chandler of storm drainage facilities outside its City Limits. Urban developments exist now outside the City Limits and within this Report Area. The trend is toward more noncontiguous development in this Report Area.

Developers of modern housing and commercial facilities need water and sewerage services from Chandler in this Report Area. The City could establish as prerequisite to these services, the project's conformance to a drainage plan compatible with an adopted City of Chandler drainage plan for that sub-basin. This procedure could provide control on public land including streets and ponding areas. However, private property ponding could not be perpetuated without enforcement authority. To the degree that lots were filled in, runoff would increase and surface flooding would increase downstream.

In a voluntary program, developers could provide adequate ponding on lots, provide street drainage to a public park pond site, and deed the park land to the City or County for maintenance and control. Purchase by the City is assumed for park-pond sites within the present City Limits.

It is not assured that the County floodway system for this Report Area will be completed within the ten-year program of this Report. It is not practical to schedule drainage facilities for the City of Chandler extending all the way to the Gila River. A reasonable alternate disposal plan is to provide one large, deep, percolation basin for each sub-basin when needed in the program. This concept is adopted in Alternate Plans 1 and 2 for sub-basins scheduled for development first.

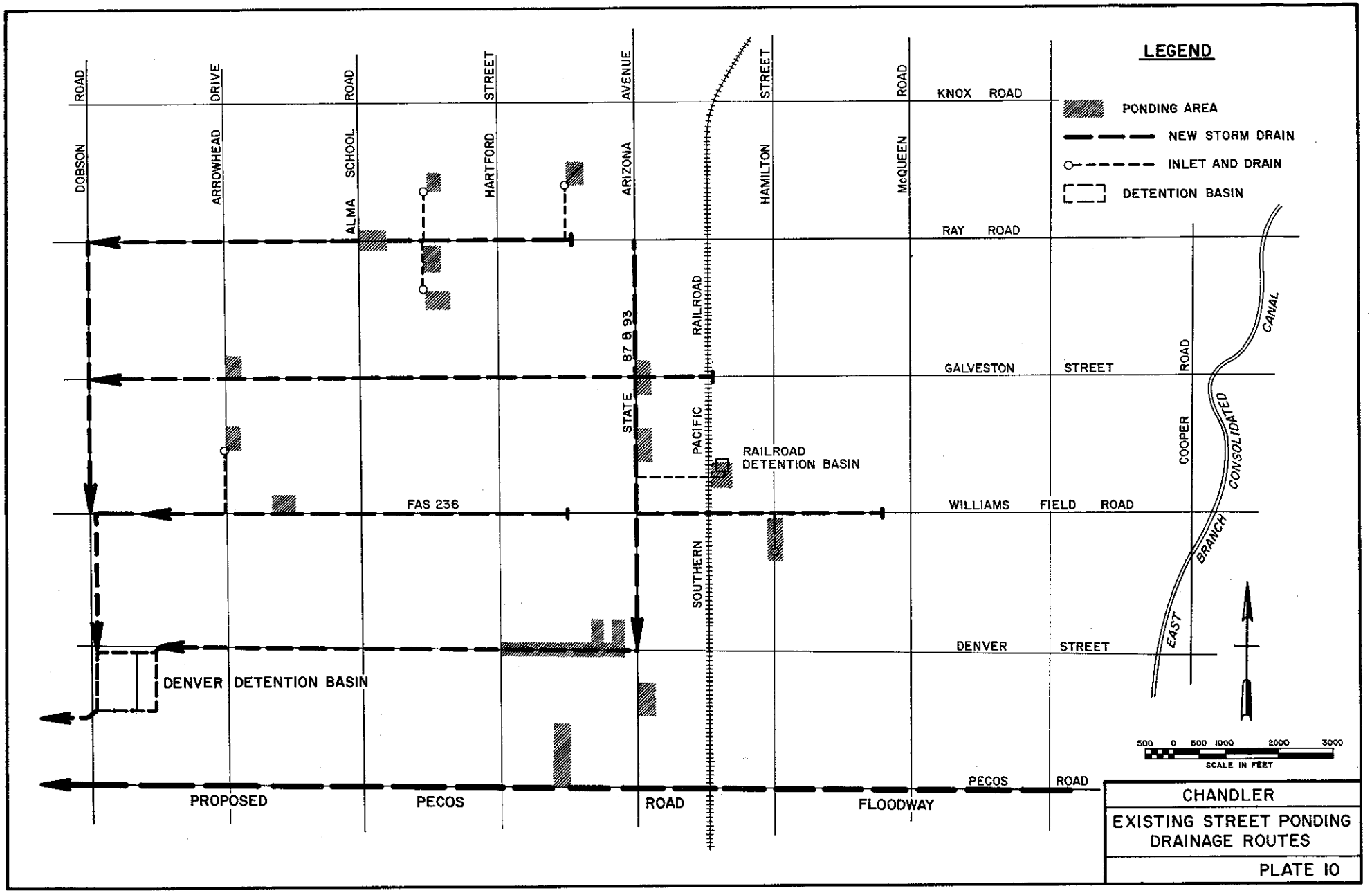
Existing problems revealed in this study are relatively minor problems. Shallow ponding in street intersections and unimproved low areas was reported. Surface drainage from these locations is not practical because of inadequate slopes along possible drainage routes. Subsurface drainage by catch basins and piping can relieve these problems in coordination with the ten-year program for Sub-Basin 1 (central).

Problem areas at six locations are listed below, and their relief is indicated on Plate 10.

PONDING PROBLEM AREAS

1. Hamilton Street south of Williams Field Road.
2. East of Southern Pacific RR at Detroit Street.
3. Arizona Avenue at Denver Street.
4. Arrowhead Drive west of Alma School Road.
5. Evergreen Street at Ivanhoe Street.
6. Evergreen Street at Orchid Lane.

Sump pits which exist at locations indicated on Plate 5 have provided temporary relief from local ponding problems. These pits filled with coarse aggregate receive ponded storm water at a top entrance, fill, and percolate water to the natural soil. In most locations the capacities of these pits have decreased by silting action and are now inadequate. When their remaining effectiveness is no longer needed because of other drainage relief, these pits should be covered over to minimize percolation of potentially harmful wastewater to the groundwater below.


LEGEND
PONDING AREA
NEW STORM DRAIN
INLET AND DRAIN
DETENTION BASIN
DOBSON ROAD
ARROWHEAD DRIVE
ALMA SCHOOL ROAD
HARTFORD STREET
ARIZONA AVENUE
HAMILTON STREET
McQUEEN ROAD
KNOX ROAD
RAY ROAD
GALVESTON STREET
WILLIAMS FIELD ROAD
DENVER STREET
PECOS ROAD
STATE 87 & 93
PACIFIC RAILROAD
SOUTHERN RAILROAD
RAILROAD DETENTION BASIN
FAS 236
DENVER DETENTION BASIN
PROPOSED PECOS ROAD FLOODWAY
COOPER ROAD
EAST BRANCH CONSOLIDATED CANAL
500 0 500 1000 2000 3000
SCALE IN FEET
CHANDLER
EXISTING STREET PONDING DRAINAGE ROUTES
PLATE 10

Section 10

ALTERNATE CAPITAL IMPROVEMENT PROGRAMS

Three capital improvement programs have been studied and compared. They are alternatives to the extent that they could serve the same area and would be required in the same time period but subject to completion of floodways. They would not each provide the same degree of protection. They would not be equal in cost.

These three plans have each been developed to serve the two urban growth areas indicated on Plate 2, page 3-3.

Plan A would provide for unrestricted runoff during a one-year frequency storm in conformance to Arizona State Highway Department (AHD) criteria.

Plan B would differ only in providing for a lesser rainfall, one-half of the one-year frequency.

Plan C would differ from Plan A only in providing for restricted runoff from subdivision lots and streets.

These storm drain plans are not feasible for the following reasons: 1) Pipe sizes are great due to moderate land slopes. 2) Disposal of storm water is dependent upon completion of Gila Drain and Pecos Road Floodways. 3) The cost of these plans are excessive for the City of Chandler. A preliminary ten-year capital improvement program for each plan is described in the Appendix.

Alternate Plans 1 and 2 include disposal basins and are not dependent upon completion of floodways. Peak flows are moderated by local ponding.

Non-Arizona Highway Department criteria proven in practice in other Arizona cities is utilized. The system is practical for areas where some

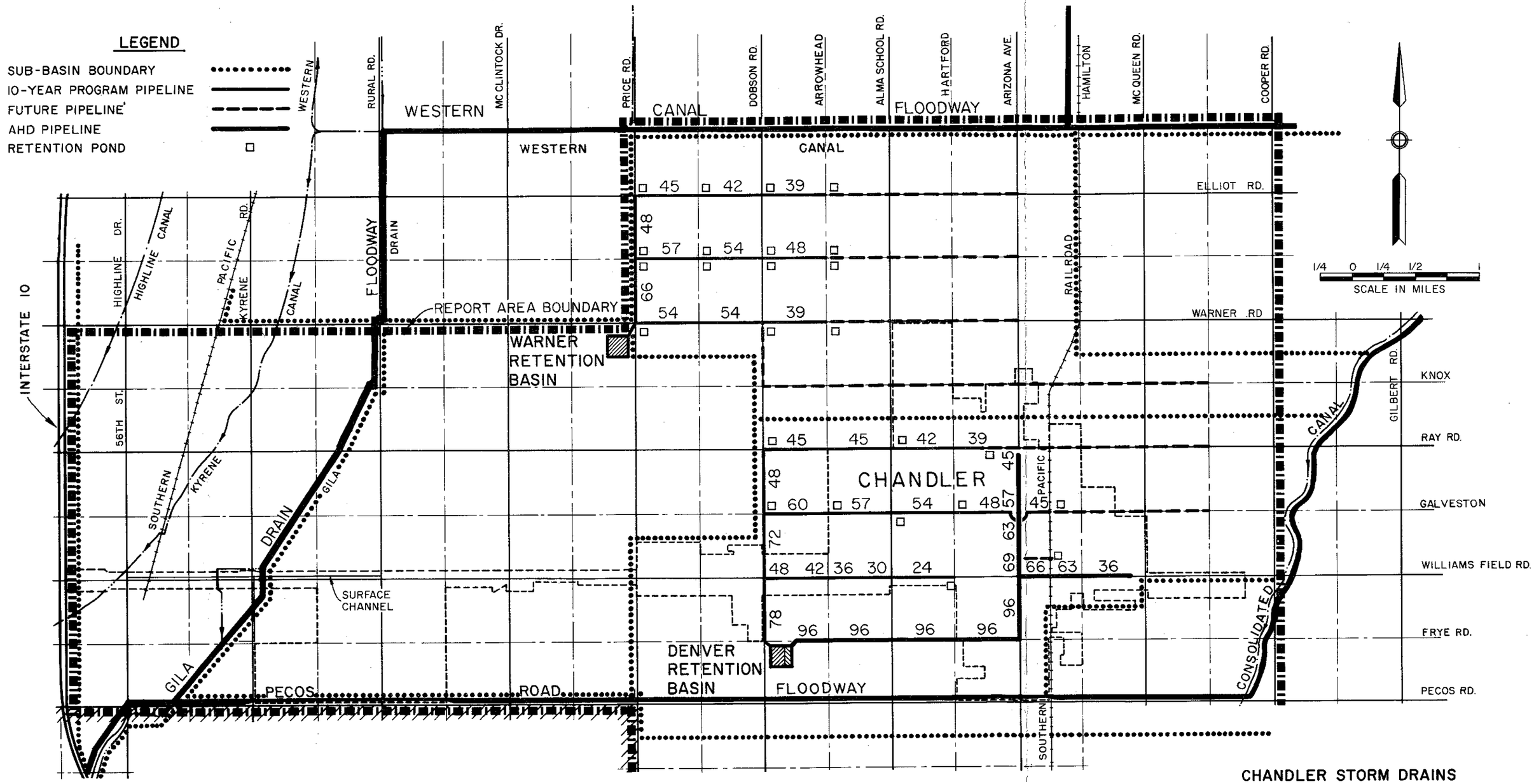
protection is judged necessary but more ponding, inconvenience, and minor damage is tolerable at lesser cost.

Storm Drainage Plan 1 would require that there be no runoff from property for the half of one-year frequency rainfall. Depressed lot areas would be required for all new developments. Runoff from the street system would be directed to detention ponds of two-foot depth and design storm capacity. Storm drains at half mile intervals are designed to convey outflow from ponds to retention basins for disposal by percolation.

Storm Drainage Plan 2 would differ from Plan 1 in providing for retention of one foot of storm water in each pond for disposal by percolation. Storm drain and retention basin size is thereby reduced.

Elements of Plan 1 are indicated on Plate 11. This system can be constructed in stages as listed in Table 3, Plan 1. Estimated costs in this capital improvement program are also tabulated. These estimated costs include construction costs, incidental costs (engineering, legal, financing, and interest during construction), plus escalation from 1974 to the year of construction of each stage.

Plan 1 would serve four sub-basins. Sub-Basin 1 (central) would include City of Chandler projects plus State and Federal Aid Highway Projects on Arizona Avenue and East Williams Field Road. The proposed Denver Retention Basin would be constructed southeast of the intersection of Frye Road and Dobson Road. The design would provide twenty-four hour runoff capacity for both City and highway drainage systems. The retention basin function would be to accept storm water at high inflow rates and retain the storm water until percolated underground.



CHANDLER STORM DRAINS
ALTERNATE PLAN I
1975-1985 PROGRAM

PLATE 11

Table 3

PLAN 1

TEN-YEAR CAPITAL IMPROVEMENT PROGRAM

Costs in Thousands of Dollars

Item	Capital Improvement	Quantity	Cost Fiscal Yr 1974	City of Chandler Escalated Projects Cost - 10 Percent per Year Fiscal Year Ending June 30, 1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
				1.20*	1.30	1.40	1.50	1.60	1.70	1.80	1.90	2.00	2.10
			$	$	$	$	$	$	$	$	$	$	$
	STATE AND FEDERAL AID HIGHWAY PROJECTS												
	10-Year Frequency												
	Sub-Basin 1 (central)												
1	Denver Retention Basin Construction	1 Ea	250										
	Storm Drain Construction												
2	Denver Street: Dobson Rd to Arizona Ave	9,400 LF	1,166										
3	Arizona Avenue: Denver St to Ray Rd	8,000 LF	680										
4	East Williams Field Rd: Arizona Ave to McQueen Rd	4,800 LF	282										
	Highway Projects Total		2,378	City of Chandler Portion Indeterminate									
	CITY OF CHANDLER PROJECTS												
	Half 1-Year Frequency												
	Sub-Basin 1 (central)												
5	Land: Ponds	30 Ac	240	144	156								
6	Urban Retention Pond Construction	10 Ea	150		98	105							
7	Retention Basin Construction	1 Ea	325			455							
	Transmission Storm Drain Construction												
8	Dobson Road: Denver St to Ray Rd	8,000 LF	622				933						
9	Ray Road: Dobson Rd to Arizona Ave	8,700 LF	411					658					
10	Williams Field Rd: Dobson Rd to Hartford St	6,600 LF	304						517				
11	Galveston Street: Dobson Rd to S.P.R.R.	12,000 LF	715							630	694		
12	Miscellaneous Inlets and Piping	5 Ea	150					48	51	54	57	60	
	Sub-Basin 1 Total		2,917										
	Sub-Basin 3 (north)												
13	Land: Ponds and Basin	85 Ac	680		416	252	270						
14	Urban Retention Pond Construction	15 Ea	225				150	200					
15	Retention Basin Construction	1 Ea	360						612				
	Storm Drain Construction												
16	Price Road: Warner Rd to Elliot Rd	5,400 LF	350							630			
17	Elliot Road: Price Rd to Arrowhead Dr	8,000 LF	363								690		
18	Mesquite Road: Price Rd to Arrowhead Dr	8,000 LF	469									938	
19	Warner Road: Price Rd to Arrowhead Dr	8,000 LF	431										905
	Sub-Basin 3 Total		2,878										
	Sub-Basins 2 (west) and 4 (Highline)												
	Surface Drainage Channels												
20	Kyrene Road: Williams Field Rd to Denver St	4,000 LF	28					45					
21	Williams Field Road: Highline Dr to Canal Dr	10,600 LF	32						54				
	Sub-Basins 2 and 4 Total		60										
	Chandler Projects Total		5,855										
	Annual Escalated Chandler Projects Cost			144	670	812	1,353	951	1,234	1,314	1,441	998	905
	Accumulated Chandler Projects Total												9,822

* Escalation factor

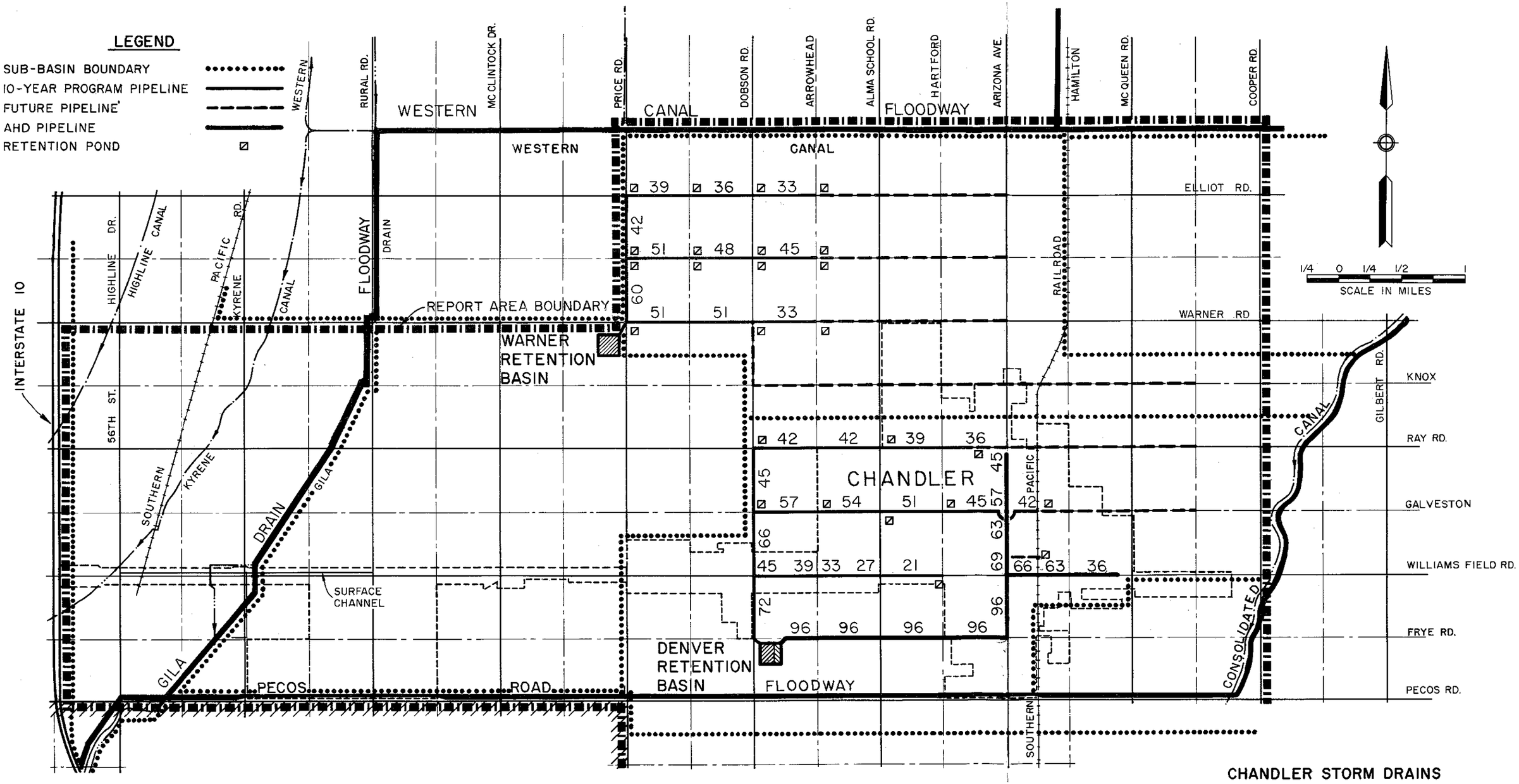
Sub-Basin 2 (west) would include a surface channel with culvert across Williams Field Road at Kyrene Road to convey surface flow to the Gila Drain.

Sub-Basin 3 (north) would provide storm drain piping emptying into the proposed Warner Retention Basin in the vicinity of Price Road and Warner Road. Elements of Sub-Basin 3 (north), Plan 1, are scheduled for stage construction as listed in Table 3, Plan 1.

Sub-Basin 4 (highline) has more favorable drainage slopes, and interim use of surface drainage channels will suffice through this ten-year program.

Elements of Plan 2 are indicated on Plate 12. This system can be constructed in a ten-year stage schedule at those estimated costs entered in Table 4, Plan 2. Estimated costs in this ten-year capital improvement program are also tabulated. These estimated costs include construction costs, incidental costs (engineering, legal, financing, and interest during construction), plus escalation from 1974 to the year of construction of each stage.

Plan 2 would serve four sub-basins. Sub-Basin 1 (central) would include City of Chandler storm drain piping plus State and Federal Aid Highway Projects on Arizona Avenue and East Williams Field Road. The proposed Denver Retention Basin would be constructed southeast of the intersection of Frye Road and Dobson Road. The design would provide twenty-four hour storm runoff capacity for the City drainage system. The retention basin function would be to accept storm water inflow peak rate and retain the storm water until percolated underground.



CHANDLER STORM DRAINS
ALTERNATE PLAN 2
1975-1985 PROGRAM

PLATE 12

Sub-Basin 2 (west) would include a surface channel with culvert across Williams Field Road at Kyrene Road to convey surface flow to the Gila Drain.

Sub-Basin 3 (north) would provide storm drain piping emptying into the proposed Warner Retention Basin in the vicinity of Price Road and Warner Road. Elements of Sub-Basin 3 (north), Plan 2, are scheduled for stage construction in Table 4, Plan 2.

Sub-Basin 4 (highline) has more favorable drainage slopes, and interim use of surface drainage channels will suffice through this ten-year program.

Plate 16 included in the Appendix is an overall pond and basin plan for the Report Area. The plan shows storm drain routes between urban retention ponds and retention basins provided for disposal of half the one-year frequency rainfall.

Table 4

PLAN 2

TEN-YEAR CAPITAL IMPROVEMENT PROGRAM

Costs in Thousands of Dollars

Item	Capital Improvement	Quantity	Cost Fiscal Yr 1974	City of Chandler Escalated Projects Cost - 10 Percent per Year Fiscal Year Ending June 30, 1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
				1.20*	1.30	1.40	1.50	1.60	1.70	1.80	1.90	2.00	2.10
			$	$	$	$	$	$	$	$	$	$	$
	STATE AND FEDERAL AID HIGHWAY PROJECTS												
	10-Year Frequency												
	Sub-Basin 1 (central)												
1	Denver Retention Basin Construction	1 Ea	250										
	Storm Drain Construction												
2	Denver Street: Dobson Rd to Arizona Ave	9,400 LF	1,166										
3	Arizona Avenue: Denver St to Ray Rd	8,000 LF	680										
4	East Williams Field Rd: Arizona Ave to McQueen Rd	4,800 LF	282										
	Highway Projects Total		2,378	City of Chandler Portion Indeterminate									
	CITY OF CHANDLER PROJECTS												
	Half 1-Year Frequency												
	Sub-Basin 1 (central)												
5	Land: Ponds	30 Ac	240	144	156								
6	Urban Retention Pond Construction	10 Ea	150		98	105							
7	Retention Basin Construction	1 Ea	250			350							
	Storm Drain Construction												
8	Dobson Road: Denver St to Ray Rd	8,000 LF	566				849						
9	Ray Road: Dobson Rd to Arizona Ave	8,700 LF	379					606					
10	Williams Field Rd: Dobson Rd to Hartford St	6,600 LF	274						466				
11	Galveston Street: Dobson Rd to S.P.R.R.	12,000 LF	670							594	646		
12	Miscellaneous Inlets and Piping	5 Ea	150					48	51	54	57	60	
	Sub-Basin 1 Total		2,679										
	Sub-Basin 3 (north)												
13	Land: Ponds and Basin	85 Ac	680		416	252	270						
14	Urban Retention Pond Construction	15 Ea	225				150	200					
15	Retention Basin Construction	1 Ea	220						374				
	Storm Drain Construction												
16	Price Road: Warner Rd to Elliot Rd	5,400 LF	306							551			
17	Elliot Road: Price Rd to Arrowhead Dr	8,000 LF	312								593		
18	Mesquite Road: Price Rd to Arrowhead Dr	8,000 LF	419									838	
19	Warner Road: Price Rd to Arrowhead Dr	8,000 LF	394										827
	Sub-Basin 3 Total		2,556										
	Sub-Basins 2 (west) and 4 (Highline)												
	Surface Drainage Channels												
20	Kyrene Road: Williams Field Rd to Denver St	4,000 LF	28					45					
21	Williams Field Road: Highline Dr to Canal Dr	10,600 LF	32						54				
	Sub-Basins 2 and 4 Total		60										
	Chandler Projects Total		5,295										
	Annual Escalated Chandler Projects Cost			144	670	707	1,269	899	945	1,199	1,296	898	827
	Accumulated Chandler Projects Total												8,854

* Escalation factor

APPENDIX A

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Existing Report Area Utilities and Transportation Systems	A-2
2-Year 6-Hour Precipitation Map	A-3
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Rainfall Depth - Duration Diagram	A-5
Alternate Partial Storm Drain Plans A, B, and C	A-6
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Plan B, Table	A-11
Plan C, Plate 15	A-13
Plan C, Table	A-14
Pond and Basin Plan, Plate 16	A-17

APPENDIX B

Proposed Elements in a City of Chandler Grading and Drainage Ordinance Required in Implementation of Alternate Plan 2, 1973 Storm Drainage System Report	B-1

REFERENCES

1. Hydrologic Design for Highway Drainage in Arizona, Dec. 1968; Bridge Division of Arizona Highway Department.

2. Technical Paper No. 40, Jan. 1963; U.S. Weather Bureau.

3. Drainage of Highway Pavements, March 1969, Hydraulic Engineering Bulletin No. 12; U.S. Department of Transportation, Federal Highway Administration Bureau of Public Roads.

4. Zoning Map, Jan. 1973; City of Chandler, Arizona.

5. U.S.G.S. 7.5 Min. Quadrangles - 1952, Guadalupe, Chandler, Gila Butte NW, Gila Butte NE.

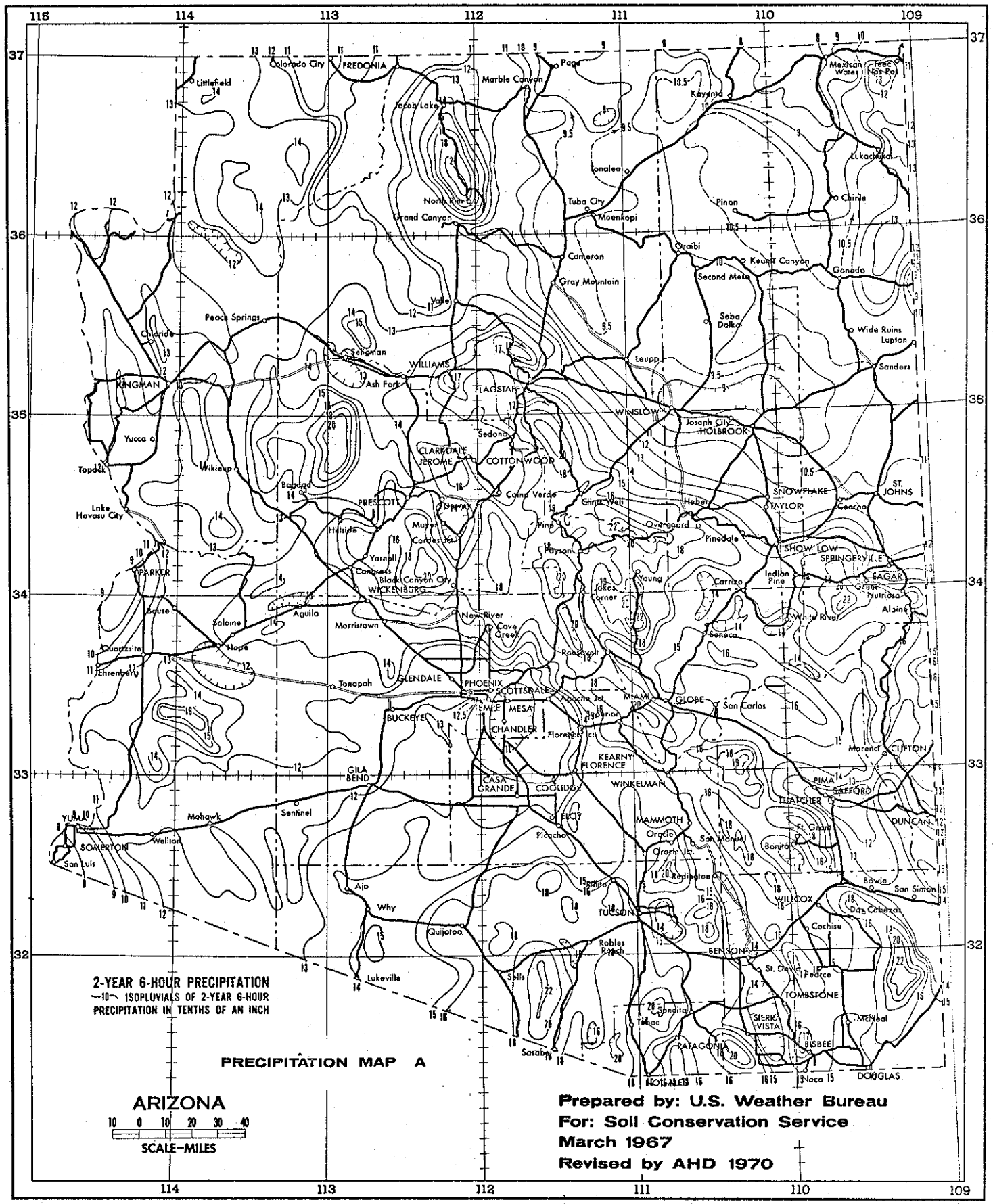
6. Preliminary Drainage Study of Casa Grande-Mesa Highway (Chandler Streets Section) 1969; Arizona Highway Department.

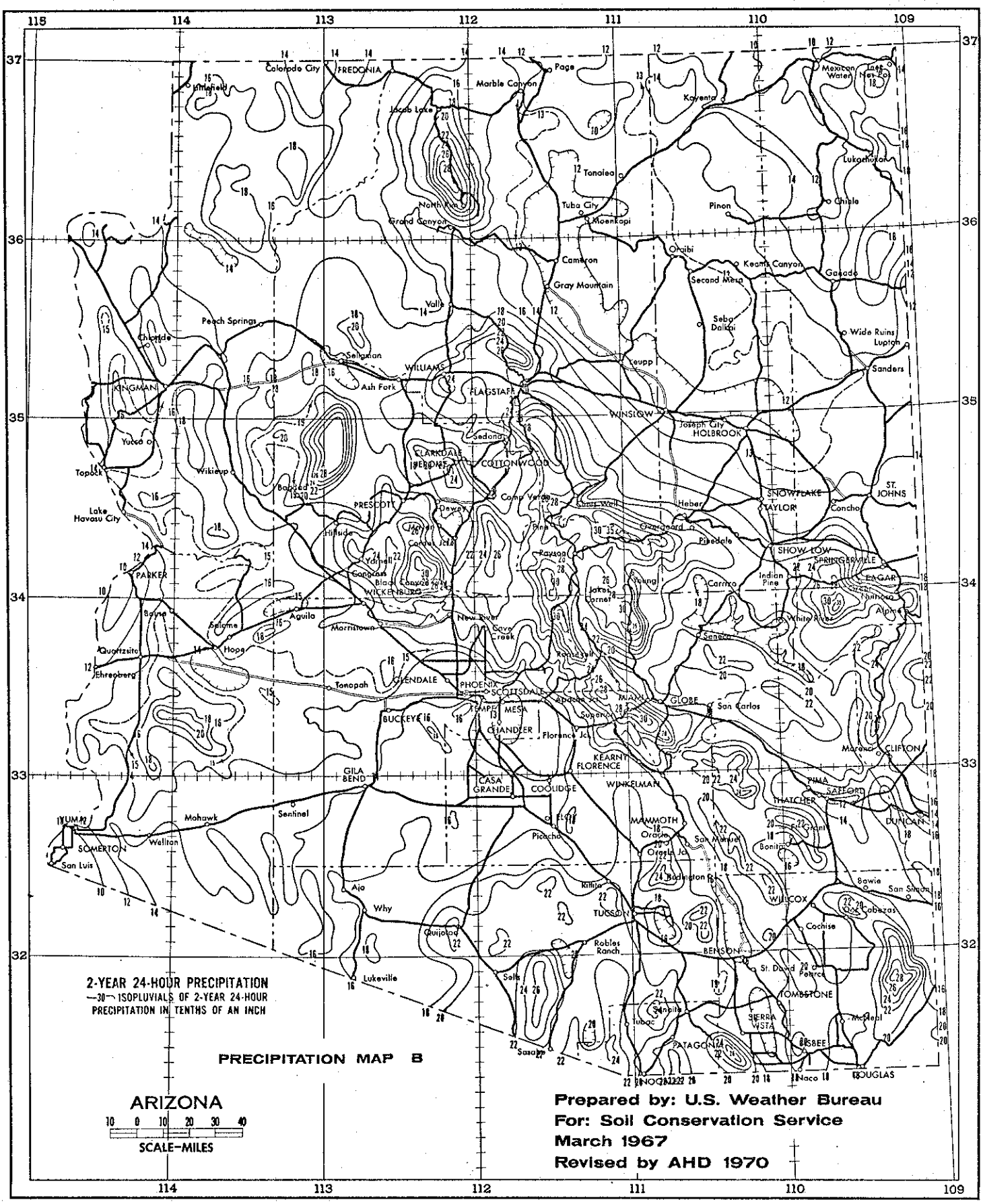
7. Storm Drainage Report for Maricopa Association of Governments 1970; Yost and Gardner Engineers.

8. Storm Drainage and Flood Control Study, June 1973, Maricopa County; Boyle Engineering Corporation and L. H. Bell and Associates.

EXISTING REPORT AREA UTILITIES AND TRANSPORTATION SYSTEMS

1. Arizona Public Service Company: Gas and power distribution.
2. Salt River Project: Irrigation water and power distribution.
3. Mountain States Telephone and Telegraph Company.
4. American Telephone and Telegraph: Coaxial cable.
5. El Paso Natural Gas Company: High pressure transmission pipeline.
6. Southern Pacific Pipelines, Inc.: Petroleum transmission pipeline.
7. Southern Pacific Transportation Company: Railroad.
8. Arizona Highway Department: Interstate and State routes.
9. Maricopa County Highway Department: County roads.
10. Maricopa County Flood Control District: Floodways.
11. City of Chandler: Streets.
12. City of Chandler: Water system.
13. City of Chandler: Sewer system.


2-YEAR 6-HOUR PRECIPITATION
—10— ISOPLUVIALS OF 2-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH
PRECIPITATION MAP A
ARIZONA
10 0 10 20 30 40
SCALE--MILES
Prepared by: U.S. Weather Bureau
For: Soil Conservation Service
March 1967
Revised by AHD 1970
Colorado City
FREDONIA
Page
Marble Canyon
Kayenta
Mexican Water
Fort Defiance
Littlefield
Jacob Lake
Tonalea
Lukachukai
North Rim
Grand Canyon
Tuba City
Moenkopi
Pinon
Chinle
Oraibi
Keams Canyon
Ganado
Cameron
Gray Mountain
Second Mesa
Seba Dalkai
Wide Ruins
Lupton
Peach Springs
Valle
Chloride
Seligman
WILLIAMS
Ash Fork
Leupp
Sanders
KINGMAN
FLAGSTAFF
WINSLOW
Joseph City
HOLBROOK
Yucca
Sedona
CLARKDALE
JEROME
COTTONWOOD
Topock
Wikieup
Bagdad
Camp Verde
Clints Well
Heber
SNOWFLAKE
TAYLOR
ST. JOHNS
Concho
Lake Havasu City
PRESCOTT
Prescott Jct.
Mayer
Pine
Overgaard
Pinedale
Hillside
Payson
SHOW LOW
SPRINGERVILLE
EAGAR
Yarnell
Congress
Black Canyon City
WICKENBURG
Young
Gila Corner
Carrizo
Indian Pine
Grant
Nutrioso
Alpine
PARKER
Aguila
Morristown
New River
Cave Creek
White River
Seneca
Bouse
Salome
Hope
Quartzsite
Ehrenberg
Roosevelt
Tonopah
GLENDALE
PHOENIX
SCOTTSDALE
Apache Jct.
MIAMI
GLOBE
San Carlos
BUCKEYE
TEMPE
MESA
CHANDLER
Florence Jct.
Morenci
CLIFTON
KEARNY
FLORENCE
GILA BEND
CASA GRANDE
COOLIDGE
WINKELMAN
PIMA
SAFFORD
THATCHER
YUMA
Mohawk
Sentinel
ELOY
Picacho
MAMMOTH
Oracle
San Manuel
Ft. Grant
Bonita
DUNCAN
SOMERTON
Wellton
San Luis
Oracle Jct.
Kartchner
Bowie
San Simon
Ajo
Why
TUCSON
WILLCOX
Dos Cabezas
Cochise
Quijotoa
Robles Ranch
BENSON
St. David
Pearce
Lukeville
Sells
TOMBSTONE
Sonoita
Tubac
SIERRA VISTA
McNeal
Sasabe
PATAGONIA
BISBEE
NOGALES
Naco
DOUGLAS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SCALE-MILES
Prepared by: U.S. Weather Bureau
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Page
Marble Canyon
Colorado City
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Tonalea
Tuba City
Moenkopi
Grand Canyon
Cameron
Gray Mountain
Kayenta
Pinon
Chinle
Lukachukai
Ganado
Keams Canyon
Second Mesa
Oraibi
Sebo Dalkai
Wide Ruins
Lupton
Sanders
Peach Springs
Seligman
Ash Fork
WILLIAMS
FLAGSTAFF
KINGMAN
Yucca
Topock
Lake Havasu City
Wikieup
Bagdad
WINSLOW
Joseph City
HOLBROOK
Sedona
CLARKDALE
JEROME
COTTONWOOD
Camp Verde
PRESCOTT
Dewey
Chino Valley
Heber
Overgaard
Pinedale
SNOWFLAKE
TAYLOR
ST. JOHNS
Concho
SHOW LOW
SPRINGERVILLE
EAGAR
Nutrioso
Alpine
Indian Pine
Carrizo
Hillside
Yarnell
Congress
Black Canyon City
WICKENBURG
Rayson
Young
Jakes Corner
PARKER
Bouse
Salome
Aguila
Morristown
New River
Cave Creek
Seneca
White River
Quartzsite
Hope
Ehrenberg
Tonopah
GLENDALE
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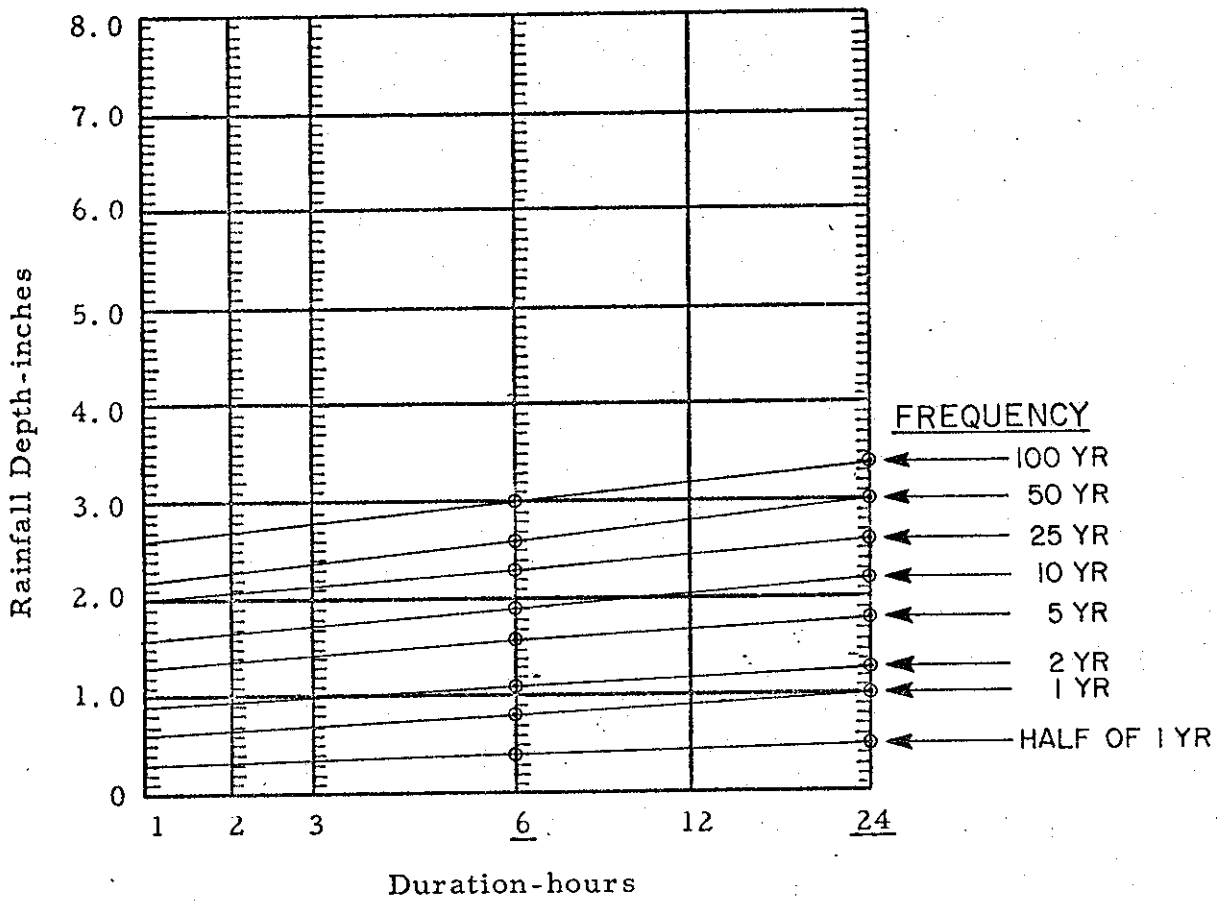
San Manuel
Bonita
Bowie
San Simon
Aja
Why
Kitt Peak
TUCSON
WILCOX
Cochise
Cabezas
Quijotoa
Robles Ranch
BENSON
St. David
Pearce
Lukeville
Sells
TOMBSTONE
Sahuarita
Tubac
SIERRA VISTA
McNeal
BISBEE
Sasabe
PATAGONIA
NOGALES
Naco
DOUGLAS



RAINFALL DEPTH - DURATION DIAGRAM

CHANDLER, ARIZONA

Source: Arizona Highway Department
Hydrologic Design and
Revised Precipitation Maps

Weather Bureau
Technical Paper No. 40

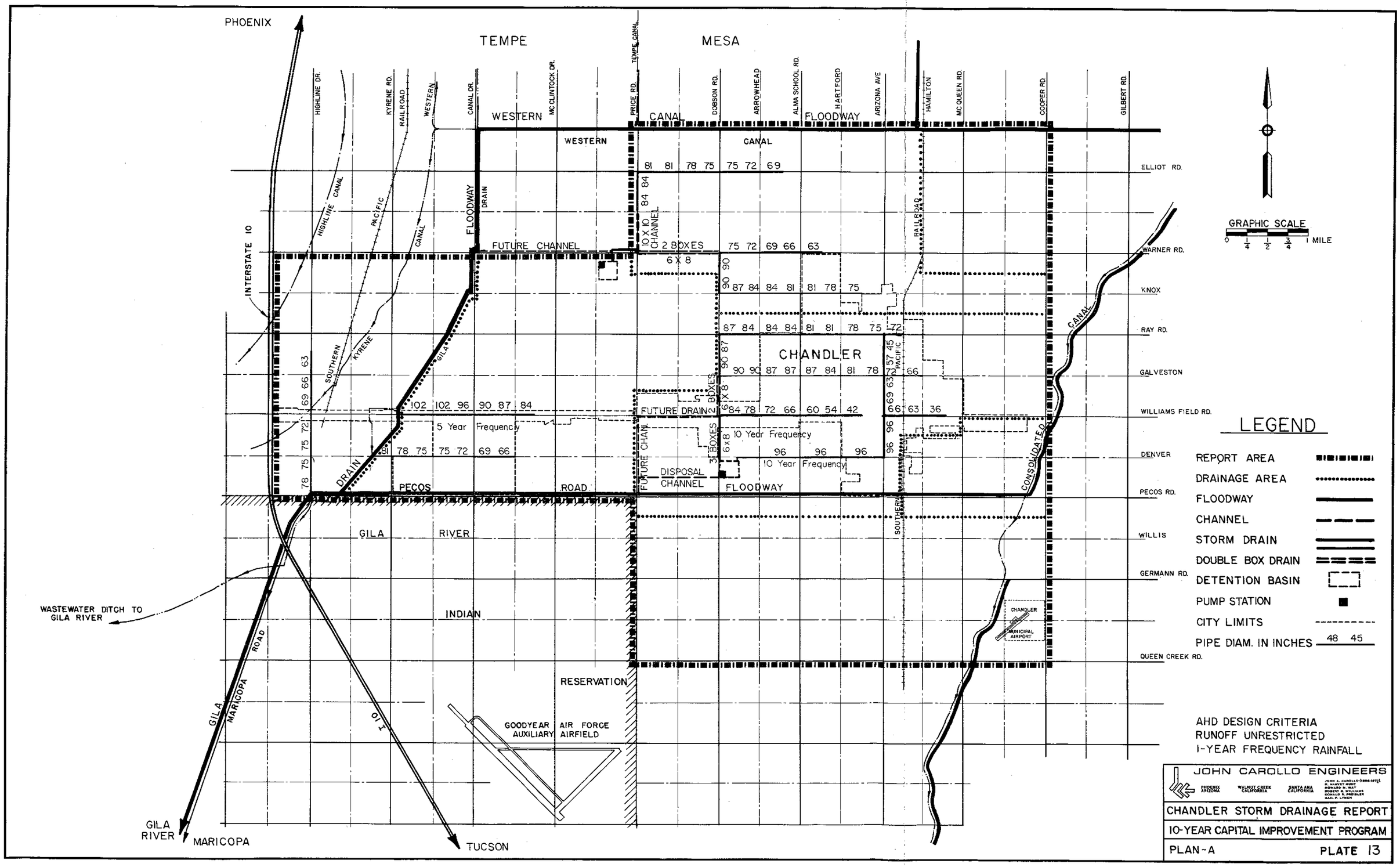
ALTERNATE PARTIAL STORM DRAIN PLANS A, B, AND C

Elements of Plan A are indicated on Plate 13. This system can be constructed in ten annual stages as listed in Table Plan A, 1976 through 1985. Total costs in this ten-year capital improvement program are also tabulated. These estimated costs include construction costs, incidental costs (engineering, legal, financing, and interest during construction), plus escalation from 1974 to the year of construction of each stage.

Plan A would serve four sub-basins. Sub-Basin 1 (central) would include storm drain piping ranging in inside diameter (ID) from 36-inch to 96-inch. Multiple concrete box culverts, each 6 feet x 8 feet, would be used on Dobson Road. The proposed Denver Detention Basin would be constructed southeast of the intersection of Frye Road and Dobson Road. The attached pumping station would have capacity to empty the detention basin storm water into the Pecos Road Floodway over a period of several days. The detention basin function would be to accept storm water inflow peak rates far in excess of reasonable pumping rates and detain excess amounts long enough to allow steady and efficient pumping rates.

Plan A for Sub-Basin 1 (central) is dependent upon prior completion of the Pecos Road Floodway.

Sub-Basin 2 (west) would provide 66-inch to 102-inch inside diameter storm drain piping along Williams Field Road and Frye Road. They would discharge into the proposed Gila Drain Floodway and would depend upon that construction prior to 1983 in the stage construction schedule for Plan A.


PHOENIX
TEMPE
MESA
CHANDLER
INDIAN RESERVATION
GILA RIVER
WESTERN CANAL
FLOODWAY
FUTURE CHANNEL
10 X 10 CHANNEL
2 BOXES
6 X 8
FUTURE DRAIN
3 BOXES
DISPOSAL CHANNEL
5 Year Frequency
10 Year Frequency
PECOS ROAD
GILA RIVER DRAIN
CONSOLIDATED CANAL
SOUTHERN PACIFIC
KYRENE
GILA
HIGHLINE CANAL
PACIFIC
RAILROAD
INTERSTATE 10
HIGHLINE DR.
KYRENE RD.
CANAL DR.
MC CLINTOCK DR.
PRICE RD.
TEMPE CANAL
DOBSON RD.
ARROWHEAD
ALMA SCHOOL RD.
HARTFORD
ARIZONA AVE
HAMILTON
MC QUEEN RD.
COOPER RD.
GILBERT RD.
ELLIOT RD.
WARNER RD.
KNOX
RAY RD.
GALVESTON
WILLIAMS FIELD RD.
DENVER
PECOS RD.
WILLIS
GERMANN RD.
QUEEN CREEK RD.
CHANDLER MUNICIPAL AIRPORT
GOODYEAR AUXILIARY AIR FORCE AIRFIELD
WASTEWATER DITCH TO GILA RIVER
GILA RIVER
MARICOPA
TUCSON
GILA MARICOPA ROAD
I 10
GRAPHIC SCALE
0 1/4 1/2 3/4 1 MILE
LEGEND
REPORT AREA
DRAINAGE AREA
FLOODWAY
CHANNEL
STORM DRAIN
DOUBLE BOX DRAIN
DETENTION BASIN
PUMP STATION
CITY LIMITS
PIPE DIAM. IN INCHES 48 45
AHD DESIGN CRITERIA
RUNOFF UNRESTRICTED
1-YEAR FREQUENCY RAINFALL
JOHN CAROLLO ENGINEERS
PHOENIX ARIZONA
WALNUT CREEK CALIFORNIA
SANTA ANA CALIFORNIA
CHANDLER STORM DRAINAGE REPORT
10-YEAR CAPITAL IMPROVEMENT PROGRAM
PLAN-A
PLATE 13

PLAN A

TEN-YEAR CAPITAL IMPROVEMENT PROGRAM

Figures Rounded to Thousands

1-YEAR FREQUENCY RAINFALL
RUNOFF UNRESTRICTED
ARIZONA HIGHWAY DEPT. CRITERIA

Item	Capital Improvement	Quantity	Cost Fiscal Yr 1974	Escalated Project Cost - 10% per Year - Fiscal Year Ending June 30									
				1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
				1.20*	1.30	1.40	1.50	1.60	1.70	1.80	1.90	2.00	2.10
			$	$	$	$	$	$	$	$	$	$	$
	STORAGE												
1	Land	50 acres	400,000	96,000	416,000								
2	Urban Detention Basin	2	70,000	42,000	46,000								
3	Denver Detention Basin	1	900,000	1,080,000									
4	Warner Detention Basin	1	900,000				1,350,000						
	PUMP STATION AND DISPOSAL CHANNEL												
5	Denver Street (to Price and Pecos)	1	340,000	408,000									
6	Warner Road (to Canal and Warner)	1	370,000					592,000					
	TRANSMISSION STORM DRAINS												
7	Denver Street: East of Dobson Road to Arizona Avenue	9,300 ft	1,153,000	1,384,000									
8	Arizona Avenue: Denver Street to Ray Road	8,000 ft	682,000	. . . .	887,000								
9	Williams Field Road: Arizona Avenue to McQueen Road	4,000 ft	246,000			344,000							
10	Williams Field Road: Dobson Road to west of Arizona Avenue	9,300 ft	697,000	. . . . .		976,000							
11	Dobson Road: Denver Street to Ray Road	7,900 ft	2,478,000			1,833,000	1,754,000						
12	Ray Road: Dobson Road to Alma School Road	5,300 ft	563,000	. . . . .			845,000						
13	Ray Road: Alma School Road to Southern Pacific RR	6,600 ft	746,000					1,194,000					
14	Price Road: Warner Road to Elliot Road	6,600 ft	1,473,000	. . . . .				2,357,000					
15	Galveston Street: Dobson Road to Hamilton Street	13,200 ft	1,315,000						2,236,000				
16	Elliot Road: Price Road to Alma School Road	9,300 ft	844,000	. . . . .					1,435,000				
17	Warner Road: Price Road to east of Alma School Road	11,900 ft	2,152,000							3,874,000			
18	Williams Field Road: Kyrene Road to west of McClintock	9,000 ft	1,229,000	. . . . .							2,335,000		
19	Dobson Road: Warner Road to Knox Road	2,700 ft	308,000								585,000		
20	Denver Street: Kyrene Road to 1/2 mile east of Canal Drive	9,300 ft	805,000	. . . . .								1,610,000	
21	Knox Road: Dobson Road to Alma School Road	5,300 ft	551,000									1,102,000	
22	Highline Drive: Pecos Road to north of Galveston	9,300 ft	788,000	. . . . .									1,655,000
23	Knox Road: Alma School Road to east of Hartford Street	4,000 ft	376,000										790,000
	Total Cost - Fiscal Year 1974		19,386,000										
	Annual Escalated Cost			3,010,000	1,349,000	3,153,000	3,949,000	4,143,000	3,671,000	3,874,000	2,920,000	2,712,000	2,445,000
	Accumulation of Cost to Fiscal Year 1985												31,226,000
	Floodway needed					Pecos Road		Gila Drain				Gila Drain	Gila Drain

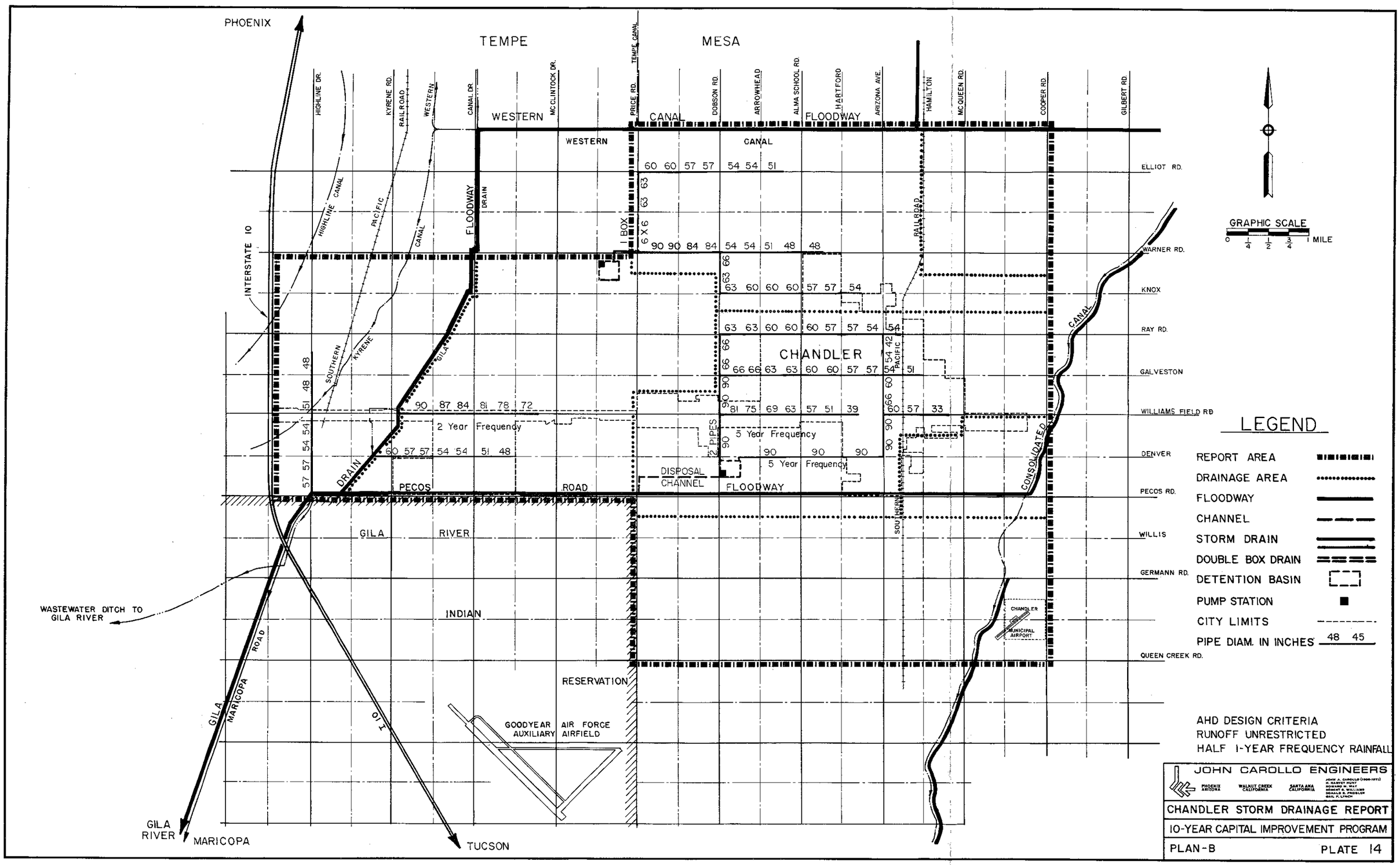
* Escalation factor

Sub-Basin 3 (north) would provide 63-inch to 90-inch inside diameter storm drain piping, two concrete box culverts 6 feet x 8 feet, and a 10-foot x 10-foot rectangular channel emptying into the proposed Warner Detention Basin. Attached pumping equipment would discharge storm water at a reduced peak rate to an open channel along Warner Road to the proposed Gila Drain Floodway. Elements of Sub-Basin 3 (north), Plan A, are scheduled for staged construction from 1979 through 1983. This schedule would require that the Gila Drain Floodway be completed prior to 1982.

Sub-Basin 4 (highline) schedule is dependent on prior construction of the Gila Drain Floodway by 1986. This storm drain piping ranges from 63-inch to 78-inch inside diameter and is planned to discharge by gravity to the Gila Drain Floodway.

Elements of Plan B are indicated on Plate 14. This system can be constructed in a 10-year staged schedule at those estimated costs entered in Table Plan B. Total costs in this 10-year capital improvement program are also tabulated. These estimated costs include construction costs, incidental costs (engineering, legal, financing, and interest during construction), plus escalation from 1974 to the year of construction of each stage.

Plan B would serve four sub-basins. Sub-Basin 1 (central) would include storm drain piping ranging in inside diameter (ID) from 33-inch to 90-inch. Multiple 90-inch pipe would be used on Dobson Road. The proposed Denver Detention Basin would be constructed southeast of the intersection of Frye Road and Dobson Road. The attached pumping station would have capacity to empty the detention basin storm water into the Pecos Road Floodway over a period of several days. The detention basin function would be to accept storm water inflow peak rates far in excess of reasonable


PHOENIX
TEMPE
MESA
HIGHLINE DR.
KYRENE RD.
RAILROAD
WESTERN
CANAL DR.
MC CLINTOCK DR.
TEMPE CANAL
PRICE RD.
DOBSON RD.
ARROWHEAD
ALMA SCHOOL RD.
HARTFORD
ARIZONA AVE.
HAMILTON
MC QUEEN RD.
COOPER RD.
GILBERT RD.
WESTERN CANAL
CANAL FLOODWAY
ELLIOT RD.
WARNER RD.
KNOX
RAY RD.
GALVESTON
WILLIAMS FIELD RD
DENVER
PECOS RD.
WILLIS
GERMANN RD.
QUEEN CREEK RD.
INTERSTATE 10
HIGHLINE CANAL
PACIFIC
CANAL
FLOODWAY
DRAIN
I BOX
6 X 6
RAILROAD
SOUTHERN
KYRENE
GILA
DRAIN
CHANDLER
PACIFIC
2 Year Frequency
5 Year Frequency
5 Year Frequency
2 PIPES
DISPOSAL CHANNEL
FLOODWAY
PECOS ROAD
GILA RIVER
INDIAN
RESERVATION
CONSOLIDATED CANAL
CHANDLER MUNICIPAL AIRPORT
GOODYEAR AUXILIARY AIR FORCE AIRFIELD
WASTEWATER DITCH TO GILA RIVER
GILA MARICOPA ROAD
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GILA RIVER
MARICOPA
TUCSON
GRAPHIC SCALE
0 1/4 1/2 3/4 1 MILE
LEGEND
REPORT AREA
DRAINAGE AREA
FLOODWAY
CHANNEL
STORM DRAIN
DOUBLE BOX DRAIN
DETENTION BASIN
PUMP STATION
CITY LIMITS
PIPE DIAM. IN INCHES 48 45
AHD DESIGN CRITERIA
RUNOFF UNRESTRICTED
HALF 1-YEAR FREQUENCY RAINFALL
JOHN CAROLLO ENGINEERS
PHOENIX ARIZONA
WALNUT CREEK CALIFORNIA
SANTA ANA CALIFORNIA
CHANDLER STORM DRAINAGE REPORT
10-YEAR CAPITAL IMPROVEMENT PROGRAM
PLAN-B
PLATE 14

PLAN B

TEN-YEAR CAPITAL IMPROVEMENT PROGRAM

Figures Rounded to Thousands

HALF OF 1-YEAR FREQUENCY RAINFALL
RUNOFF UNRESTRICTED
ARIZONA HIGHWAY DEPT. CRITERIA

Item	Capital Improvement	Quantity	Cost Fiscal Yr 1974	Escalated Project Cost - 10% per Year - Fiscal Year Ending June 30									
				1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
				1.20*	1.30	1.40	1.50	1.60	1.70	1.80	1.90	2.00	2.10
			$	$	$	$	$	$	$	$	$	$	$
	STORAGE												
1	Land	50 acres	400,000	96,000	416,000								
2	Urban Detention Basin	2	70,000	42,000	46,000								
3	Denver Detention Basin	1	900,000	1,080,000									
4	Warner Detention Basin	1	900,000				1,350,000						
	PUMP STATION AND DISPOSAL CHANNEL												
5	Denver Street (to Price and Pecos)	1	340,000	408,000									
6	Warner Road (to Canal and Warner)	1	370,000					592,000					
	TRANSMISSION STORM DRAINS												
7	Denver Street: East of Dobson Road to Arizona Avenue	9,300 ft	1,060,000	1,272,000									
8	Arizona Avenue: Denver Street to Ray Road	8,000 ft	641,000	. . . .	833,000								
9	Williams Field Road: Arizona Avenue to McQueen Road	4,000 ft	218,000			305,000							
10	Williams Field Road: Dobson Road to west of Arizona Avenue	9,300 ft	658,000	. . . . .	. . . . .	921,000							
11	Dobson Road: Denver Street to Ray Road	7,900 ft	1,102,000			832,000	762,000						
12	Ray Road: Dobson Road to Alma School Road	5,300 ft	380,000	. . . . .	. . . . .	. . . . .	570,000						
13	Ray Road: Alma School Road to Southern Pacific RR	6,600 ft	418,000					669,000					
14	Price Road: Warner Road to Elliot Road	6,600 ft	971,000	. . . . .	. . . . .	. . . . .	. . . . .	1,554,000					
15	Galveston Street: Dobson Road to Hamilton Street	13,200 ft	898,000						1,527,000				
16	Elliot Road: Price Road to Alma School Road	9,200 ft	585,000	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	995,000				
17	Warner Road: Price Road to east of Alma School Road	11,900 ft	951,000							1,712,000			
18	Williams Field Road: Kyrene Road to west of McClintock	9,000 ft	918,000	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	1,744,000		
19	Dobson Road: Warner Road to Knox Road	2,700 ft	195,000								371,000		
20	Denver Street: Kyrene Road to 1/2 mile east of Canal Drive	9,300 ft	562,000	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . .	1,124,000	
21	Knox Road: Dobson Road to Alma School Road	5,300 ft	367,000									734,000	
22	Highline Drive: Pecos Road to north of Galveston	9,300 ft	542,000	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . .	. . . .	1,138,000
23	Knox Road: Alma School Road to east of Hartford Street	4,000 ft	251,000										527,000
	Total Cost - Fiscal Year 1974		13,697,000										
	Annual Escalated Cost			2,898,000	1,295,000	2,058,000	2,682,000	2,815,000	2,522,000	1,712,000	2,115,000	1,858,000	1,665,000
	Accumulation of Cost to Fiscal Year 1985												21,620,000
	Floodway needed			. . . . .	. . . . .	Pecos Road	. . .	Gila Drain	. . . . .	. . . . .	. . . .	Gila Drain	Gila Drain

* Escalation factor

pumping rates and detain excess amounts long enough to allow steady and efficient pumping rates.

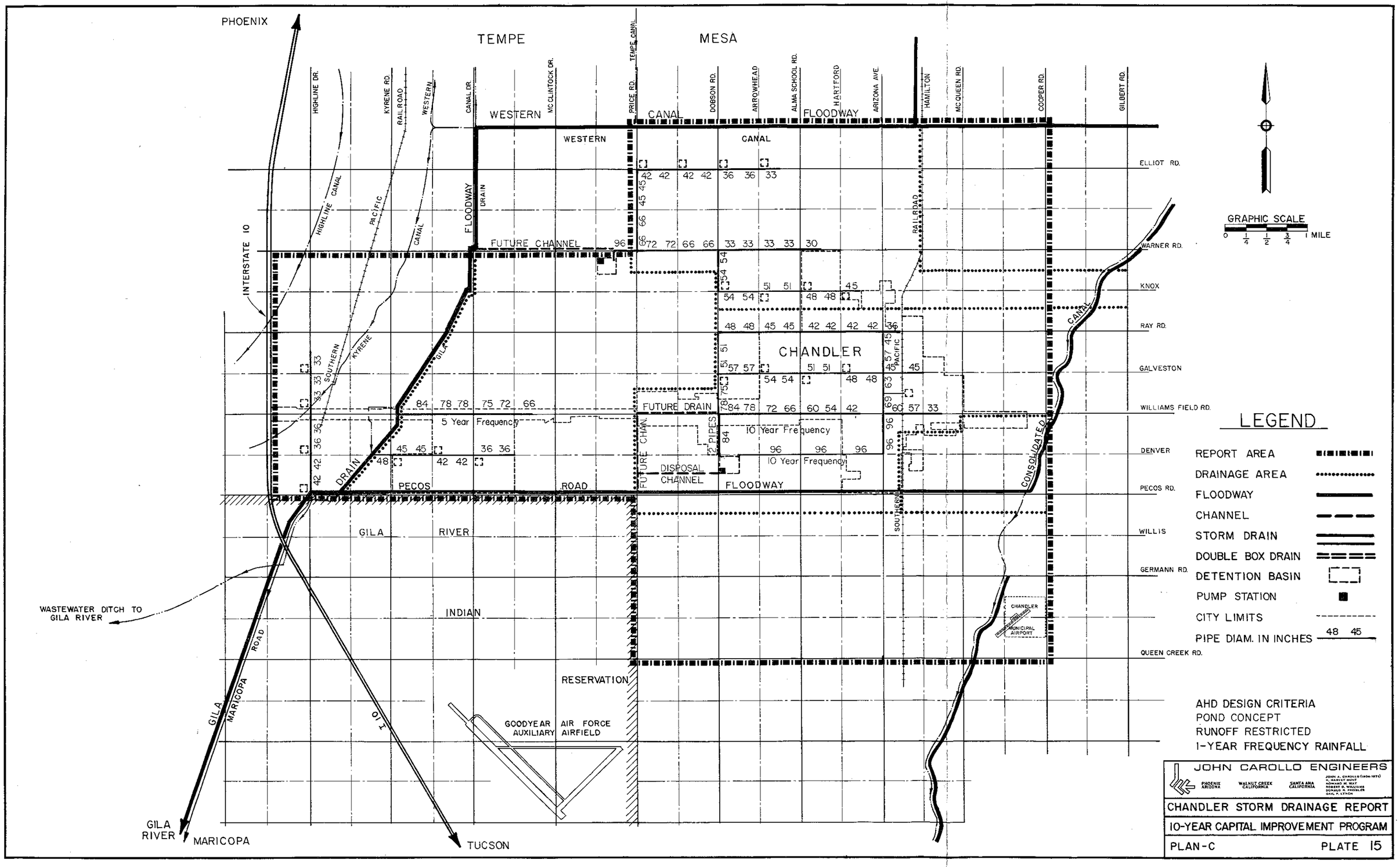
Plan B for Sub-Basin 1 (central) is dependent upon prior completion of the Pecos Road Floodway.

Sub-Basin 2 (west) would provide 48-inch to 90-inch inside diameter storm drain piping along Williams Field Road and Frye Road. They would discharge into the proposed Gila Drain Floodway and would depend upon that construction prior to 1983 in the stage construction schedule for Plan B.

Sub-Basin 3 (north) would provide 48-inch to 90-inch inside diameter storm drain piping and a 6-foot x 6-foot box culvert emptying into the proposed Warner Detention Basin. Attached pumping equipment would discharge storm water at a reduced peak rate into an open channel along Warner Road to the proposed Gila Drain Floodway. Elements of Sub-Basin 3 (north) Plan B are scheduled for stage construction from 1979 through 1983. This schedule would require that the Gila Drain Floodway be completed prior to 1982.

Sub-Basin 4 (west) schedule is dependent on prior construction of the Gila Drain Floodway by 1986. This storm drain piping ranges from 48-inch to 57-inch inside diameter and is planned to discharge by gravity to the Gila Drain Floodway.

Elements of Plan C are indicated on Plate 15. This system can be constructed in a 10-year staged schedule at those estimated costs entered in Table Plan C. Total costs in this 10-year capital improvement program are also tabulated. These estimated costs include construction costs, incidental


PHOENIX
TEMPE
MESA
HIGHLINE DR.
KYRENE RD.
RAILROAD
WESTERN
CANAL DR.
MC CLINTOCK DR.
PRICE RD.
TEMPE CANAL
DOBSON RD.
ARROWHEAD
ALMA SCHOOL RD.
HARTFORD
ARIZONA AVE.
HAMILTON
MC QUEEN RD.
COOPER RD.
GILBERT RD.
WESTERN CANAL
CANAL
FLOODWAY
ELLIOT RD.
WARNER RD.
KNOX
RAY RD.
GALVESTON
WILLIAMS FIELD RD.
DENVER
PECOS RD.
WILLIS
GERMANN RD.
QUEEN CREEK RD.
INTERSTATE 10
HIGHLINE CANAL
PACIFIC
CANAL
SOUTHERN
KYRENE
GILA
DRAIN
FLOODWAY
FUTURE CHANNEL
RAILROAD
CHANDLER
PACIFIC
FUTURE DRAIN
FUTURE CHAN.
2-PIPES
5 Year Frequency
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DISPOSAL CHANNEL
FLOODWAY
CONSOLIDATED CANAL
SOUTHERN
PECOS ROAD
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INDIAN
RESERVATION
WASTEWATER DITCH TO GILA RIVER
GILA MARICOPA ROAD
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GOODYEAR AUXILIARY AIR FORCE AIRFIELD
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GILA RIVER
MARICOPA
TUCSON
GRAPHIC SCALE
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REPORT AREA
DRAINAGE AREA
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CITY LIMITS
PIPE DIAM. IN INCHES 48 45
AHD DESIGN CRITERIA
POND CONCEPT
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1-YEAR FREQUENCY RAINFALL
JOHN CAROLLO ENGINEERS
PHOENIX ARIZONA
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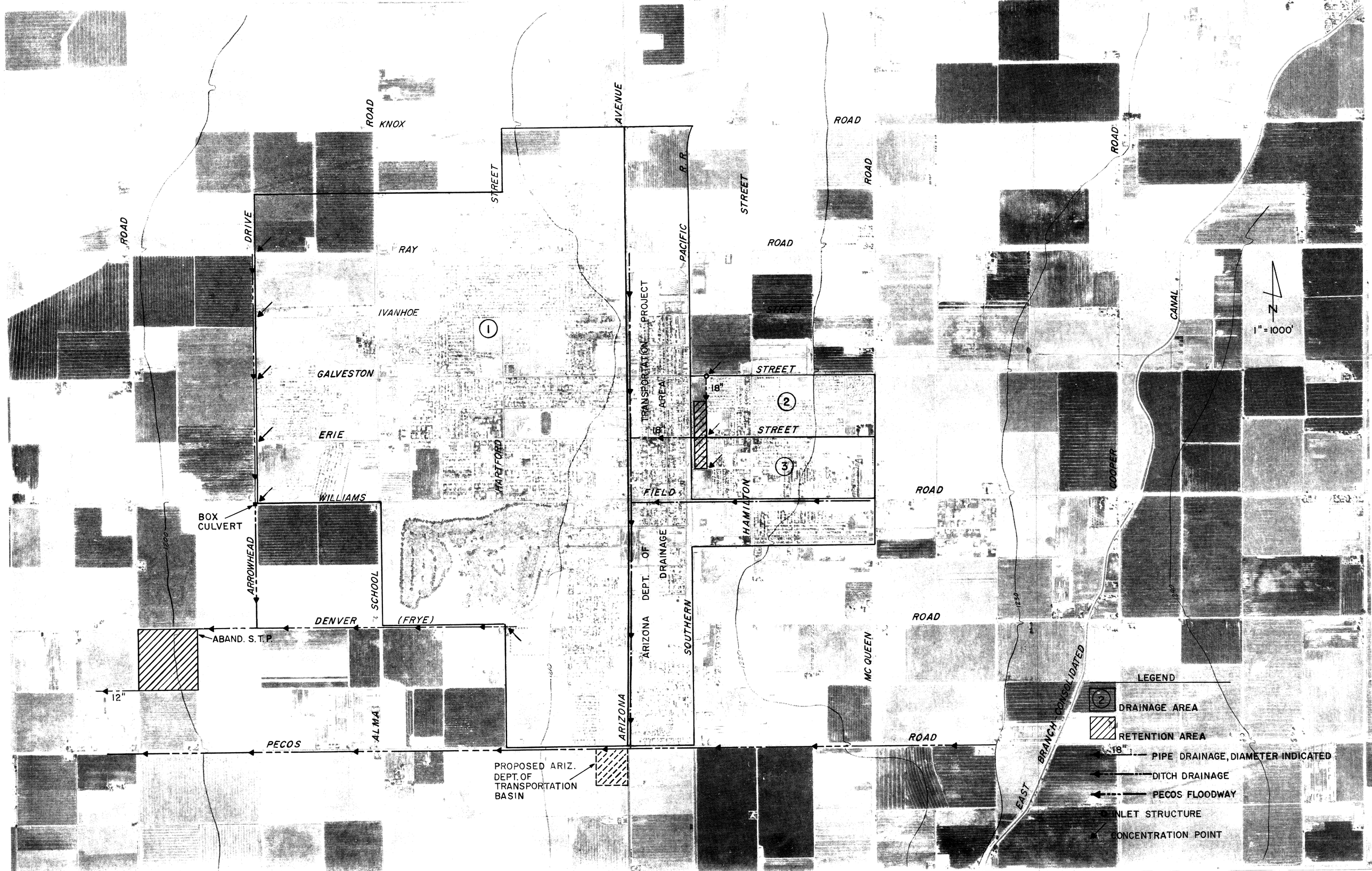
10-YEAR CAPITAL IMPROVEMENT PROGRAM
PLAN-C
PLATE 15


KNOX
ROAD
STREET
AVENUE
R.R.
PACIFIC
ROAD
STREET
ROAD
ROAD
ROAD
DRIVE
ROAD
RAY
IVANHOE
GALVESTON
ERIE
WILLIAMS
BOX CULVERT
ARROWHEAD
SCHOOL
DENVER
(FRYE)
ABAND. S.T.P.
12"
ALMA
PECOS
HARTFORD
ARIZONA DEPT. OF TRANSPORTATION PROJECT AREA
FIELD
HAMILTON
STREET
STREET
STREET
18"
18"
ARIZONA
SOUTHERN
PROPOSED ARIZ. DEPT. OF TRANSPORTATION BASIN
MC QUEEN
ROAD
ROAD
ROAD
ROAD
COOPER
CANAL
EAST BRANCH CONSOLIDATED
1220
1230
1240
1250
1"=1000'
N
LEGEND
DRAINAGE AREA
RETENTION AREA
18" PIPE DRAINAGE, DIAMETER INDICATED
DITCH DRAINAGE
PECOS FLOODWAY
INLET STRUCTURE
CONCENTRATION POINT

Note: 10 cys. to City of Chandler

JOB FILE 1948

JOHN CAROLLO ENGINEERS

PHOENIX ARIZONA | WALNUT CREEK CALIFORNIA | SANTA ANA CALIFORNIA

JOHN A. CAROLLO, P.E. (1906-1971)
H. HARVEY HUNT, P.E.
HOWARD M. WAY, P.E.
ROBERT G. WILLIAMS, P.E.
DONALD R. PREISLER, P.E.
GAIL P. LYNCH, P.E.
WALTER R. HOWARD, P.E.

3308 NORTH THIRD STREET
PHOENIX, ARIZONA 85012
AREA CODE: (602) 248-0400

October 14, 1975

City of Chandler
Public Works Department
P. O. Box 248
Chandler, Arizona 85224

Attention: Mr. Bruce B. Knutson
Public Works Director

Subject: Plan for collection of storm runoff from existing developed areas (SUPPLEMENT NO. 1 TO REPORT ON STORM DRAINAGE SYSTEM)

Gentlemen:

At your request, additional study has been devoted to developing a plan to dispose of storm water runoff and reduce street ponding in the developed area of Chandler. This area, which does not conform to the new City onsite storm water runoff retention policy, has been studied under the assumption of utilizing existing street drainage patterns and earth channels as an alternate to a pipe system.

The City of Chandler developed area, considered in this study, was divided into three drainage study areas, as shown on the accompanying map. Area 1 was studied on the basis of collecting storm water runoff from a two-year frequency storm and providing a retention basin having sufficient storage capacity for a five-year, twenty-four hour storm; Areas 2 and 3 were analyzed on the basis of collecting and storing storm water runoff from a two-year storm. The following chart summarizes the results of calculations performed to determine storage requirements.

RUNOFF DATA

Drainage Area No.	1	2	3
Contributing Area (Acres)	1750	120	120
Runoff to be Stored (Ac. Ft.)	131.3	3.9	3.9
Net Basin Area Required (Acres)	33.1	4.6	4.6
Average Depth of Basin incl. Freeboard (Ft.)	21	3	3

It was assumed that storm water runoff would follow the existing street drainage systems, flowing generally west and somewhat south. Between Ray Road and Williams Field Road in Area 1, peak flows were estimated for concentration points along Arrowhead Dr. at Ray Rd., Ivanhoe St., Galveston St., Erie Street, and Williams Field Road. Runoff from the remaining southeast part of Area 1 is expected to concentrate at the intersection of Hartford and Frye Road.

A proposed earth channel originating at Ray Road would run south along Arrowhead Drive collecting flows at Ivanhoe Street, Galveston Street, Erie Street and Williams Field Road. The crossing at Williams Field Road would require a box culvert and drop structure. The channel would then continue south 1/2 mile to Frye Road to join with an improved channel from Hartford Street to deliver storm water a quarter mile west into Frye Road detention basin. The proposed channels have been sized utilizing trapezoidal cross sections with 1-1/2:1 side slopes and capacities and dimensions as indicated in the following chart. The channels as well as the retention basins for each area will be fenced.

CHANNEL DATA

Location	Capacity (cfs)	Avg. Total Depth (Ft.)	Freeboard (Ft.)	Avg. Top Width (Ft.)
Arrowhead, from Ray to Galveston	198	6.8	2.2	23.9
Arrowhead, from Galveston to Erie	326	8.0	2.5	30.5
Arrowhead, from Erie to Williams Field Road	431	8.0	2.6	38.0
Arrowhead, box culvert crossing Williams Field Road	491	6.1	1.0	32.1
Arrowhead, Williams Field Road to Frye	491	9.6	2.8	38.2
Frye, Hartford to Arrowhead	36	8.9	1.5	20.4
Frye, Arrowhead to Retention Basin	527	9.2	2.9	36.8

In sizing the Frye Road retention basin, it was assumed that excavated material would be mounded around its perimeter. A 12-inch overflow pipe draining west from the southwest corner of the retention basin would provide an outlet to an existing irrigation channel. After construction of the Pecos Floodway, the drainage channel would be extended and joined to permit reclaiming of the storage basin property.

Runoff from Areas 2 and 3 appears to concentrate along Exeter Street at Galveston Street, Erie Street, and Detroit Street. The proposed retention basin for these areas, to be located between the Southern Pacific R.R. tracks and Exeter Street, would collect storm runoff concentrating along Exeter at Erie Street and Detroit Street. A storm drain inlet and pipe would be required to collect the water from the intersection of Galveston Street and Exeter Street. An overflow pipe can be designed to drain into the Arizona Avenue drainage system, if permission is received for accepting the water by the Arizona Department of Transportation, which is planning construction of the proposed storm drain system on Arizona Avenue. It was assumed that material from these retention basin sites would be exported.

The remaining developed area of Chandler east of Arizona Avenue along Williams Field Road was assumed to be drained by a previously designed pipe system into the Arizona Department of Transportation storm drain system.

Preliminary construction cost estimates for Area 1 and Areas 2 & 3 proposed drainage and disposal facilities are included in detail hereafter. Total estimated construction costs are as follows:

Area 1	$2,021,450
Areas 2 & 3	376,950
Total	$2,398,400

Very truly yours,

JOHN CAROLLO ENGINEERS

Donald R. Preisler

Donald R. Preisler

John H. Shannon

John H. Shannon

DRP/JHS/mh
Encls.

PRELIMINARY ESTIMATE OF CONSTRUCTION COST

DRAINAGE AREA 1

1.	Land Acquisition Gross Area of Basin Channel Right-of-way 61 Ac. @ $10,000/Ac.	 34 Ac. 27 Ac.	$ 610,000
2.	Excavation and Backfill Basin Channels 389,300 CY @ $2.00/CY	 259,900 CY 129,400 CY	778,600
3.	Pipe 1,000 LF @ $15/LF	12" RCP	15,000
4.	Box Culvert	1 LS	367,100
5.	Channel Drop Structures 4 each @ $6,800/Ea.		27,200
6.	Modification of Existing Irrigation Canals 7,900 LF @ $7.00/LF		55,300
7.	Fencing 33,650 LF @ $5.00/LF		168,250
	Total Estimated Construction Cost		$2,021,450

DRAINAGE AREAS 2 and 3

1.	Land Acquisition Gross Area of Basin 10 Ac. @ $10,000/Ac.		$ 100,000
2.	Excavation and Backfill Basin: 29,400 CY @ $2.00/CY		58,800
3.	Pipe 2,050 LF @ $33/LF	18" RCP	67,650
4.	Storm Drain Inlet 1 Each @ $1,500 Ea.		1,500
5.	Fencing 3,400 LF @ $5.00/LF		17,000
6.	Purchase and Demolition of Buildings 11 @ $12,000 Each		132,000
	Total Estimated Construction Cost		$ 376,950
	Total Estimated Project Construction Cost		$2,398,400

Note: 10 cys. to City of Chandler

JOB FILE 1948

JOHN CAROLLO ENGINEERS

PHOENIX ARIZONA | WALNUT CREEK CALIFORNIA | SANTA ANA CALIFORNIA

JOHN A. CAROLLO, P.E. (1906-1971)
H. HARVEY HUNT, P.E.
HOWARD M. WAY, P.E.
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DONALD R. PREISLER, P.E.
GAIL P. LYNCH, P.E.
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3308 NORTH THIRD STREET
PHOENIX, ARIZONA 85012
AREA CODE: (602) 248-0400

October 14, 1975

City of Chandler
Public Works Department
P. O. Box 248
Chandler, Arizona 85224

Attention: Mr. Bruce B. Knutson
Public Works Director

Subject: Plan for collection of storm runoff from existing developed areas (SUPPLEMENT NO. 1 TO REPORT ON STORM DRAINAGE SYSTEM)

Gentlemen:

At your request, additional study has been devoted to developing a plan to dispose of storm water runoff and reduce street ponding in the developed area of Chandler. This area, which does not conform to the new City onsite storm water runoff retention policy, has been studied under the assumption of utilizing existing street drainage patterns and earth channels as an alternate to a pipe system.

The City of Chandler developed area, considered in this study, was divided into three drainage study areas, as shown on the accompanying map. Area 1 was studied on the basis of collecting storm water runoff from a two-year frequency storm and providing a retention basin having sufficient storage capacity for a five-year, twenty-four hour storm; Areas 2 and 3 were analyzed on the basis of collecting and storing storm water runoff from a two-year storm. The following chart summarizes the results of calculations performed to determine storage requirements.

RUNOFF DATA

Drainage Area No.	1	2	3
Contributing Area (Acres)	1750	120	120
Runoff to be Stored (Ac. Ft.)	131.3	3.9	3.9
Net Basin Area Required (Acres)	33.1	4.6	4.6
Average Depth of Basin incl. Freeboard (Ft.)	21	3	3

It was assumed that storm water runoff would follow the existing street drainage systems, flowing generally west and somewhat south. Between Ray Road and Williams Field Road in Area 1, peak flows were estimated for concentration points along Arrowhead Dr. at Ray Rd., Ivanhoe St., Galveston St., Erie Street, and Williams Field Road. Runoff from the remaining southeast part of Area 1 is expected to concentrate at the intersection of Hartford and Frye Road.

A proposed earth channel originating at Ray Road would run south along Arrowhead Drive collecting flows at Ivanhoe Street, Galveston Street, Erie Street and Williams Field Road. The crossing at Williams Field Road would require a box culvert and drop structure. The channel would then continue south 1/2 mile to Frye Road to join with an improved channel from Hartford Street to deliver storm water a quarter mile west into Frye Road detention basin. The proposed channels have been sized utilizing trapezoidal cross sections with 1-1/2:1 side slopes and capacities and dimensions as indicated in the following chart. The channels as well as the retention basins for each area will be fenced.

CHANNEL DATA

Location	Capacity (cfs)	Avg. Total Depth (Ft.)	Freeboard (Ft.)	Avg. Top Width (Ft.)
Arrowhead, from Ray to Galveston	198	6.8	2.2	23.9
Arrowhead, from Galveston to Erie	326	8.0	2.5	30.5
Arrowhead, from Erie to Williams Field Road	431	8.0	2.6	38.0
Arrowhead, box culvert crossing Williams Field Road	491	6.1	1.0	32.1
Arrowhead, Williams Field Road to Frye	491	9.6	2.8	38.2
Frye, Hartford to Arrowhead	36	8.9	1.5	20.4
Frye, Arrowhead to Retention Basin	527	9.2	2.9	36.8

In sizing the Frye Road retention basin, it was assumed that excavated material would be mounded around its perimeter. A 12-inch overflow pipe draining west from the southwest corner of the retention basin would provide an outlet to an existing irrigation channel. After construction of the Pecos Floodway, the drainage channel would be extended and joined to permit reclaiming of the storage basin property.

Runoff from Areas 2 and 3 appears to concentrate along Exeter Street at Galveston Street, Erie Street, and Detroit Street. The proposed retention basin for these areas, to be located between the Southern Pacific R.R. tracks and Exeter Street, would collect storm runoff concentrating along Exeter at Erie Street and Detroit Street. A storm drain inlet and pipe would be required to collect the water from the intersection of Galveston Street and Exeter Street. An overflow pipe can be designed to drain into the Arizona Avenue drainage system, if permission is received for accepting the water by the Arizona Department of Transportation, which is planning construction of the proposed storm drain system on Arizona Avenue. It was assumed that material from these retention basin sites would be exported.

The remaining developed area of Chandler east of Arizona Avenue along Williams Field Road was assumed to be drained by a previously designed pipe system into the Arizona Department of Transportation storm drain system.

Preliminary construction cost estimates for Area 1 and Areas 2 & 3 proposed drainage and disposal facilities are included in detail hereafter. Total estimated construction costs are as follows:

Area 1	$2,021,450
Areas 2 & 3	376,950
Total	$2,398,400

Very truly yours,

JOHN CAROLLO ENGINEERS

Donald R. Preisler

Donald R. Preisler

John H. Shannon

John H. Shannon

DRP/JHS/mh
Encls.

PRELIMINARY ESTIMATE OF CONSTRUCTION COST

DRAINAGE AREA 1

1.	Land Acquisition Gross Area of Basin Channel Right-of-way 61 Ac. @ $10,000/Ac.	 34 Ac. 27 Ac.	$ 610,000
2.	Excavation and Backfill Basin Channels 389,300 CY @ $2.00/CY	 259,900 CY 129,400 CY	778,600
3.	Pipe 1,000 LF @ $15/LF	12" RCP	15,000
4.	Box Culvert	1 LS	367,100
5.	Channel Drop Structures 4 each @ $6,800/Ea.		27,200
6.	Modification of Existing Irrigation Canals 7,900 LF @ $7.00/LF		55,300
7.	Fencing 33,650 LF @ $5.00/LF		168,250
	Total Estimated Construction Cost		$2,021,450

DRAINAGE AREAS 2 and 3

1.	Land Acquisition Gross Area of Basin 10 Ac. @ $10,000/Ac.		$ 100,000
2.	Excavation and Backfill Basin: 29,400 CY @ $2.00/CY		58,800
3.	Pipe 2,050 LF @ $33/LF	18" RCP	67,650
4.	Storm Drain Inlet 1 Each @ $1,500 Ea.		1,500
5.	Fencing 3,400 LF @ $5.00/LF		17,000
6.	Purchase and Demolition of Buildings 11 @ $12,000 Each		132,000
	Total Estimated Construction Cost		$ 376,950
	Total Estimated Project Construction Cost		$2,398,400

PLAN C

TEN-YEAR CAPITAL IMPROVEMENT PROGRAM

Figures Rounded to Thousands

1-YEAR FREQENCY RAINFALL
RUNOFF RESTRICTED
ARIZONA HIGHWAY DEPT. CRITERIA

Item	Capital Improvement	Quantity	Cost Fiscal Yr 1974	Escalated Project Cost - 10% per Year - Fiscal Year Ending June 30 1976 1.20*	1977 1.30	1978 1.40	1979 1.50	1980 1.60	1981 1.70	1982 1.80	1983 1.90	1984 2.00	1985 2.10
			$	$	$	$	$	$	$	$	$	$	$
	STORAGE AND DISPOSAL												
1	Land	80 acres	640,000	192,000	416,000	224,000							
2	Urban Detention Basins	12	420,000	42,000	46,000	98,000	105,000	112,000	119,000	126,000			
3	Denver Detention Basin	1	900,000	1,080,000									
4	Warner Detention Basin	1	900,000				1,350,000						
	PUMP STATION AND DISPOSAL CHANNEL												
5	Denver Street (to Price and Pecos)	1	340,000	408,000									
6	Warner Road (to Canal and Warner)	1	370,000					592,000					
	TRANSMISSION STORM DRAINS												
7	Denver Street: East of Dobson Road to Arizona Avenue	9,300 ft	1,153,000	1,384,000									
8	Arizona Avenue: Denver Street to Ray Road	8,000 ft	680,000	. . . .	884,000								
9	Williams Field Road: Arizona Avenue to McQueen Road	4,600 ft	274,000			384,000							
10	Williams Field Road: Dobson Road to west of Arizona Avenue	9,300 ft	697,000	. . . . .	. . . . .	976,000							
11	Dobson Road: Denver Street to Ray Road	7,900 ft	926,000			756,000	579,000						
12	Ray Road: Dobson Road to Alma School Road	5,300 ft	263,000	. . . . .	. . . . .	. . . . .	395,000						
13	Ray Road: Alma School Road to Southern Pacific RR	6,600 ft	289,000					462,000					
14	Price Road: Warner Road to Elliot Road	5,300 ft	345,000	. . . . .	. . . . .	. . . . .	. . . . .	552,000					
15	Galveston Street: Dobson Road to Hamilton Street	13,200 ft	743,000						1,263,000				
16	Elliot Road: Price Road to Alma School Road	9,300 ft	403,000	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	685,000				
17	Warner Road: Price Road to east of Alma School Road	13,200 ft	844,000							1,519,000			
18	Williams Field Road: Kyrene Road to west of McClintock	9,000 ft	837,000	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	1,590,000		
19	Dobson Road: Warner Road to Knox Road	2,700 ft	162,000								308,000		
20	Denver Street: Kyrene Road to 1/2 mile east of Canal Drive	9,300 ft	430,000	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	860,000	
21	Knox Road: Dobson Road to Alma School Road	5,300 ft	308,000									616,000	
22	Highline Drive: Pecos Road to north of Galveston	9,300 ft	375,000	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	788,000
23	Knox Road: Alma School Road to east of Hartford Street	4,000 ft	193,000										405,000
	Total Cost - Fiscal Year 1974		12,492,000										
	Annual Escalated Cost			3,106,000	1,346,000	2,438,000	2,429,000	1,718,000	2,067,000	1,645,000	1,898,000	1,476,000	1,193,000
	Accumulation of Cost to Fiscal Year 1985												19,316,000
	Floodway needed			. . . . .	. . . . .	Pecos Road	. . .	Gila Drain	. . . . .	. . . . .	. . . . .	Gila Drain	Gila Drain

* Escalation factor

costs (engineering, legal, financing, and interest during construction), plus escalation from 1974 to the year of construction of each stage.

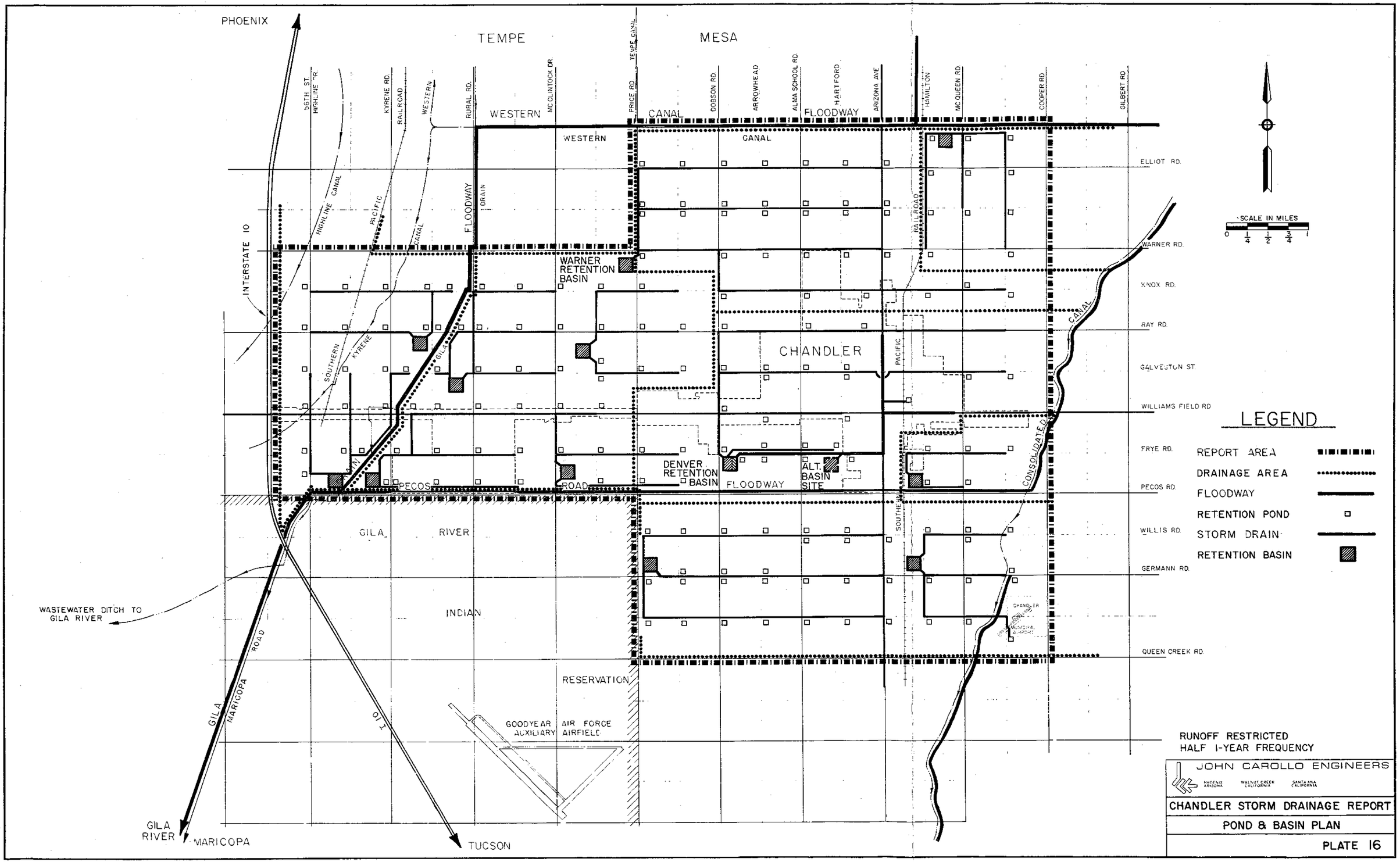
Plan C would serve four sub-basins. Sub-Basin 1 (central) would include storm drain piping ranging in inside diameter (ID) from 30-inch to 96-inch. Multiple 84-inch pipe would be used on Dobson Road. The proposed Denver Detention Basin would be constructed southeast of the intersection of Frye Road and Dobson Road. The attached pumping station would have capacity to empty the detention basin storm water into the Pecos Road Floodway over a period of several days. The detention basin function would be to accept storm water inflow peak rates far in excess of reasonable pumping rates and detain excess amounts long enough to allow steady and efficient pumping rates.

Plan C for Sub-Basin 1 (central) is dependent upon prior completion of Pecos Road Floodway.

Sub-Basin 2 (west) would provide 36-inch to 84-inch inside diameter storm drain piping along Williams Field Road and Frye Road. They would discharge into the proposed Gila Drain Floodway and would depend upon that construction prior to 1983 in the stage construction schedule for Plan C.

Sub-Basin 3 (north) would provide 30-inch to 72-inch inside diameter storm drain piping and a 96-inch inside diameter storm drain pipe emptying into the proposed Warner Detention Basin. Attached pumping equipment would discharge storm water at a reduced peak rate into an open channel along Warner Road to the proposed Gila Drain Floodway. Elements of Sub-Basin 3 (north) Plan C are scheduled for stage construction from 1979 through 1983. This schedule would require that the Gila Drain Floodway be completed prior to 1982.

Sub-Basin 4 (west) schedule is dependent on prior construction of the Gila Drain Floodway by 1986. This storm drain piping ranges from 33-inch to 42-inch inside diameter and is planned to discharge by gravity to the Gila Drain Floodway.


PHOENIX
TEMPE
MESA
56TH ST.
HIGHLINE RD.
KYRENE RD.
RAILROAD
WESTERN
RURAL RD.
MC CLINTOCK DR.
PRICE RD.
TEMPE CANAL
DOBSON RD.
ARROWHEAD
ALMA SCHOOL RD.
HARTFORD
ARIZONA AVE
HAMILTON
MC QUEEN RD.
COOPER RD.
GILBERT RD.
WESTERN CANAL
FLOODWAY
CANAL
ELLIOT RD.
WARNER RD.
KNOX RD.
RAY RD.
GALVESTON ST.
WILLIAMS FIELD RD.
FRYE RD.
PECOS RD.
WILLIS RD.
GERMANN RD.
QUEEN CREEK RD.
INTERSTATE 10
HIGHLINE CANAL
PACIFIC
RAILROAD
WESTERN CANAL
FLOODWAY
DRAIN
WARNER RETENTION BASIN
SOUTHERN
KYRENE
GILA
CHANDLER
PACIFIC
RAILROAD
CANAL
CONSOLIDATED
DENVER RETENTION BASIN
FLOODWAY
ALT. BASIN SITE
PECOS
ROAD
GILA
RIVER
INDIAN
RESERVATION
SOUTHERN
CHANDLER MUNICIPAL AIRPORT
GOODYEAR AUXILIARY AIR FORCE AIRFIELD
WASTEWATER DITCH TO GILA RIVER
GILA MARICOPA ROAD
I 10
GILA RIVER
MARICOPA
TUCSON
SCALE IN MILES
0 1/4 1/2 3/4 1
LEGEND
REPORT AREA
DRAINAGE AREA
FLOODWAY
RETENTION POND
STORM DRAIN
RETENTION BASIN
RUNOFF RESTRICTED
HALF 1-YEAR FREQUENCY
JOHN CAROLLO ENGINEERS
PHOENIX ARIZONA
WALNUT CREEK CALIFORNIA
SANTA ANA CALIFORNIA
CHANDLER STORM DRAINAGE REPORT
POND & BASIN PLAN
PLATE 16

PROPOSED ELEMENTS IN A CITY OF CHANDLER GRADING AND DRAINAGE ORDINANCE REQUIRED IN IMPLEMENTATION OF ALTERNATE PLAN 2, 1973 STORM DRAINAGE SYSTEM REPORT

PURPOSE

1. Establish the official Plan for storm water runoff control within a defined Chandler Storm Drain Planning Area.

2. Define the Chandler Storm Drain Planning Area.

3. Create educational procedures needed to inform the public.

4. Delegate the enforcement authority as needed to implement and maintain the program.

GENERAL PLAN

1. Establish the official Chandler Storm Drain Plan by City Council adoption and designation of proposed Alternate Plan 2, 1973 Storm Drainage System Report.

2. City Council declare as necessary to the public welfare and safety, and to activation of the Plan, the application of detention and retention of storm water runoff on both private and public property.

3. Prohibit alterations to private property within the Planning Area which can result in any storm water discharge from the parcel of private property and from an amount of rainfall less than 0.1 foot in depth over the gross area of the private property parcel.

4. Prohibit alteration of surfaces in public right-of-way within the Planning Area which can result in any storm water runoff from that

right-of-way due to an amount of rainfall less than 0.1 foot in depth over the gross area of that public right-of-way to other than detention/retention ponds designated in the Plan.

AUTHORITY DELEGATION

1. Reserve to the City Council authority to alter designated location or construction features of detention/retention ponds.

2. Delegate to the Public Works Director authority and responsibility to review each proposed variance from the Plan and to recommend to the City Council appropriate response.

3. Delegate to the Public Works Director authority and responsibility to review each proposed project for property outside of, but within three miles of the City Limits, to interpret to the Maricopa County Board of Supervisors compliance or variance of each proposed project with the Plan, and to request appropriate approval or disapproval therefore as regards compliance with the Plan.

REFINED PLANS

Authorize and require the Public Works Director to have prepared, and modified from time to time, a refined Plan for each Sub-Basin within the Chandler Planning Area which details, to the extent his judgment deems necessary, these specific items:

1. Surface drainage terminus for each 160-acre tract of land or smaller parcel.

2. Surface drainage routes on all tracts.

3. Surface drainage control elevations on all drainage routes.

4. Location, area, depth, elevation, and surface development of each detention/retention pond to be utilized.

5. Location, elevations, size, and material of construction required in pipelines from each detention/retention pond to its corresponding retention basin.

6. Location, elevation, size, and surface development of each retention basin required in the Plan.

GUIDELINES

Authorize and require the Public Works Director to establish guidelines for use by private citizens in planning for their projects to conform to requirements of the Plan. These guidelines are to include a map of the Quarter-Section under review and all contiguous Quarter-Sections and indicating thereon: two-foot interval contours of existing topography; street surface control elevations at Quarter-Section corners; location, bottom elevation, retention capacity, and detention capacity of a preliminary pond design for each Quarter-Section; a line diagram of the six cubic feet per second pipeline capacity required from each pond to the retention basin; and the location, area, and high-water elevation of each retention basin. The guidelines are also to include instructions for submittal of concept variances for review.