REPORT

STORM DRAINAGE SYSTEM FOR WEST TEMPE

TEMPE, ARIZONA

1972

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Registered Professional Engineer, Mechanical, CERTIFICATE NO. 2501, DONALD R. PREISLER, Date Signed 8/15/72, ARIZONA, U.S.A.

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PHOENIX, ARIZONA 85012
AREA CODE: (602) 265-4796

November 13, 1972

Honorable Mayor and Council
City of Tempe
City Hall
Tempe, Arizona

Gentlemen:

Submitted herewith is our Report on a Storm Drainage System for West Tempe. This Report covers the area between the Salt River on the north and Guadalupe Road on the south, and from 48th Street on the west to one-half mile east of Rural Road, excepting those areas already served. The Report includes hydrologic and hydraulic calculations, route selection, recommended improvements, and estimated costs for right-of-way acquisition and construction.

We wish to thank the members of your Public Works staff for furnishing information and data necessary for the preparation of this Report.

Respectfully submitted,

JOHN CAROLLO ENGINEERS

Donald R. Preisler

Donald R. Preisler, Partner
Arizona Registration No. 2501

Robert G. Welman

Robert G. Welman, Engineer
Arizona Registration No. 3027

DRP/lc

REPORT

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Registered Professional Engineer (Civil, Mechanical)
CERTIFICATE NO. 2501
DONALD R. WEIMER
Date Signed 7-22-72
ARIZONA, U.S.A.

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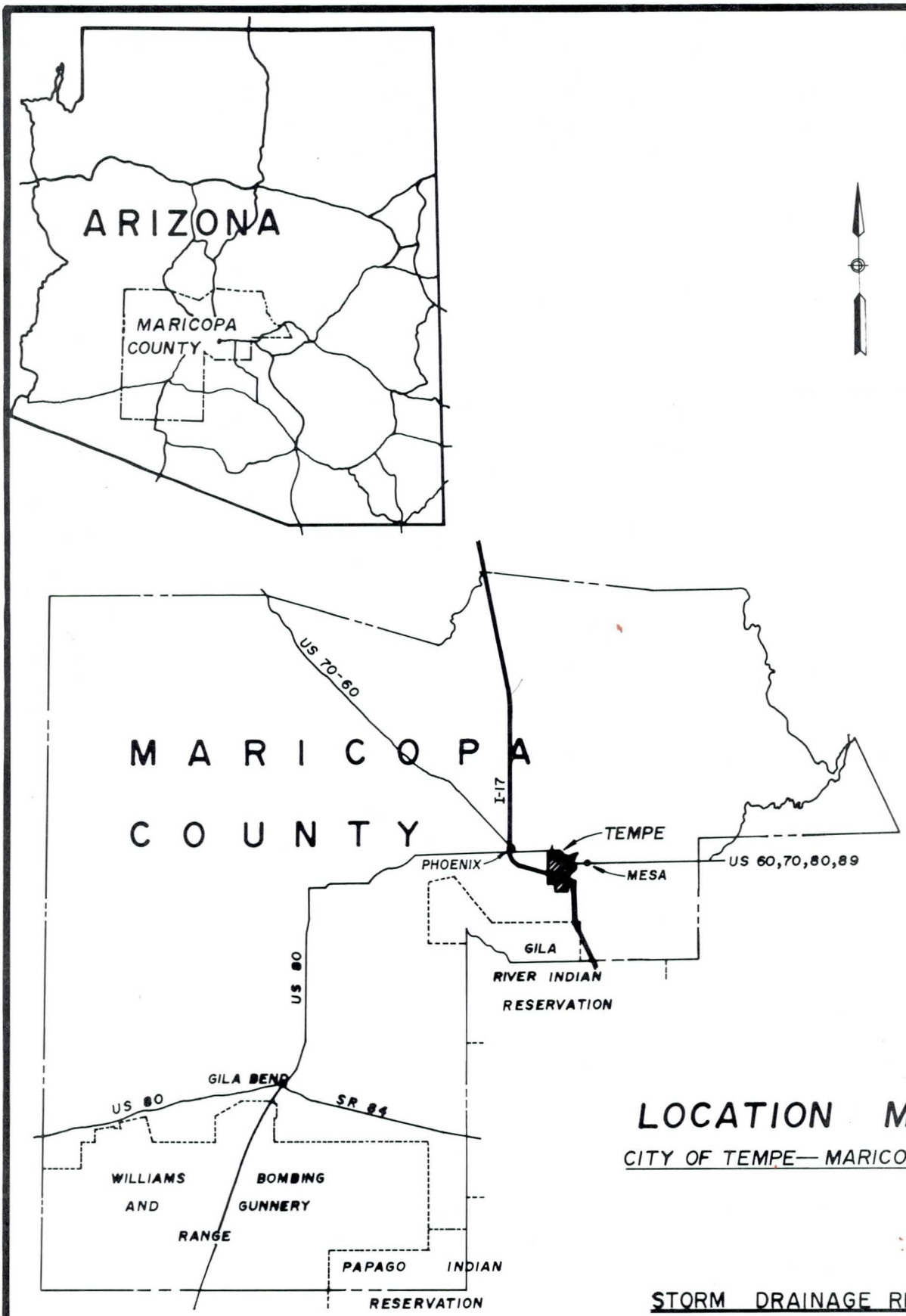
Section 1

PURPOSE AND SCOPE

The purpose of this Report is to present the results of our study of the various elements associated with storm drainage in west Tempe. The study includes hydrological data, determination of drainage areas, existing drainage facilities, estimate of runoff, development of a plan to remove runoff, required rights-of-way, and estimate of costs.

The study area defined by the Contract is bounded by the Salt River on the north, Guadalupe Road on the south, 48th Street on the west, and approximately one-half mile east of Rural Road on the east, except the area served by the Farmer Avenue main. Plate 1 indicates the report area location. Plate 2 indicates the study area.

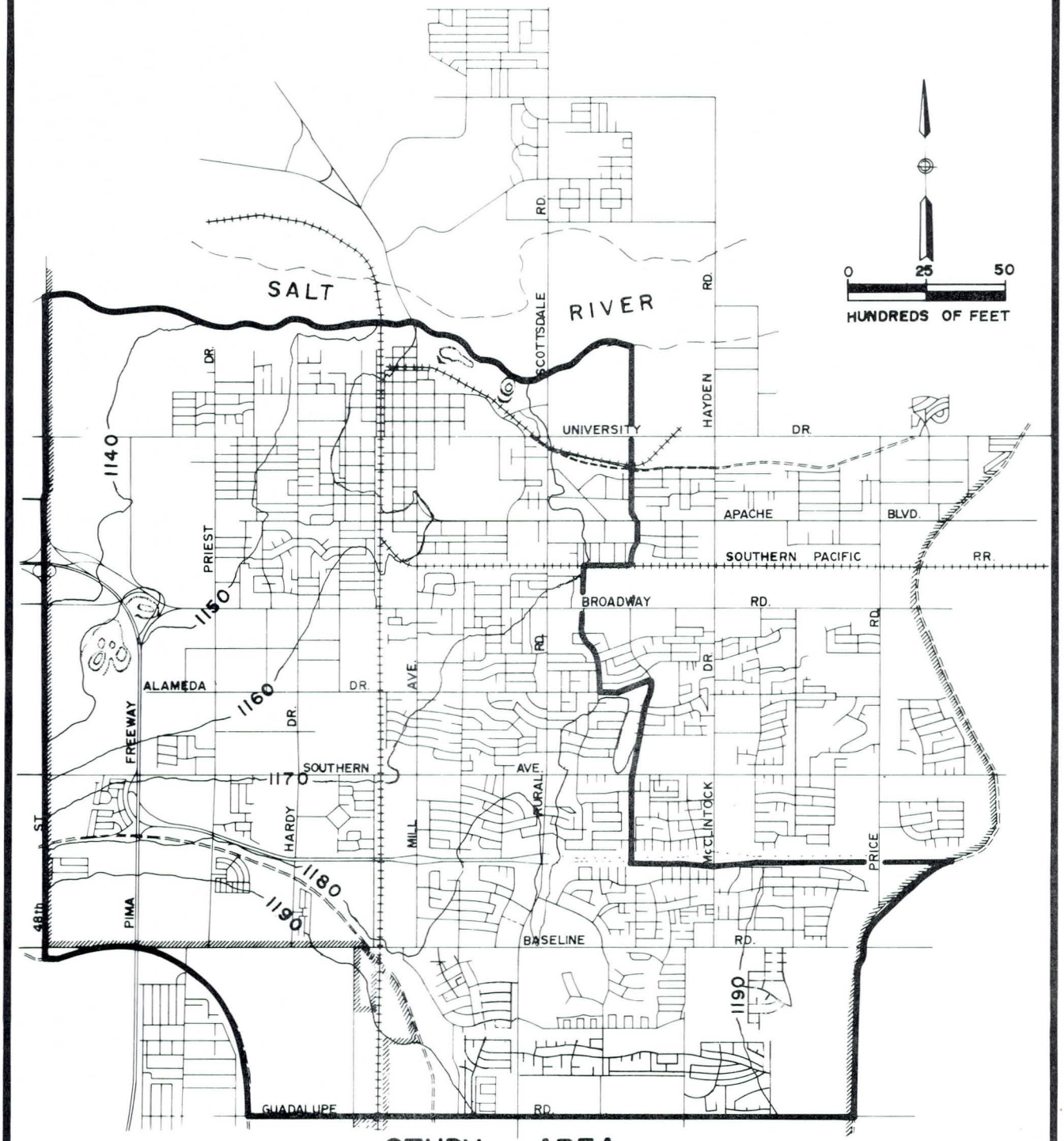
Runoff rates and rainfall intensity duration curves were established in accordance with the Arizona Highway Department Bridge Division in its publication "Hydrologic Design for Highway Drainage in Arizona"; ASCE Manual of Practice No. 9; United States Weather Bureau "Technical Paper No. 40"; City of Tempe Zoning Map (Revised to January 1972); Preliminary General Plan for City of Tempe and Environs; and certain conditions stipulated in the Contract.



LOCATION MAP

CITY OF TEMPE— MARICOPA COUNTY

STORM DRAINAGE REPORT



STUDY AREA

STORM DRAINAGE REPORT

TEMPE, ARIZONA

Section 2

AREA

The study area contains 17.4 square miles of land sloping generally to the north and west, as indicated on Plate 2. Most of the land has been graded for irrigation with a general slope of two to four feet per one thousand feet. The study area is intersected by two major man-made barriers that prevent normal flow. These barriers are the Superstition Freeway and the Western Canal. Special crossings will be required at five locations beneath each of the barriers

The area between Baseline Road on the north and Guadalupe on the south, Tempe Canal on the east and the Western Canal on the west is very flat. The present developments have planned self-contained storm systems. The Lakes development will drain all of their storm runoff into their lakes. University Royal and College Park Subdivisions plan to drain runoff through a local storm drain system into a retention basin. The Salt River Project will pump storm water from the retention basin into the Western Canal at a time suitable to their irrigation schedules. Subdivisions being planned now for all of Section 1 and the south half of Section 2, T1S, R4E will contain all storm runoff on the property, and the storm runoff from the streets and sidewalks will be conducted by a proposed storm drain west along Southshore Drive and north on Rural Road to the Freeway. This storm drain is designed and will be constructed in July or August. Also under construction is a new storm drain along the south side of the Freeway from Dorsey Lane west to Rural Road, intercepting the above mentioned drain, then continuing west to College Avenue. This new storm drain connects to an existing 69-inch pipe beneath the Freeway.

The area between Farmer Avenue on the east and 48th Street on the west, 5th Street on the south, and the canal north of 2nd Street on the north will drain to the south and west and concentrate at Priest and University Drives.

The area between Pima Freeway on the east, 48th Street on the west, Highline Canal on the south, and the Tempe Drainage District No. 2 Ditch on the north will drain northerly along 48th Street and concentrate at the Tempe drainage ditch.

The remaining area will drain northwesterly to concentrate at 52nd Street and the Tempe drainage ditch to combine with concentrations from the University Drive area. The total combined flow will continue westerly to 48th Street to be further combined with flows from 48th Street lateral west of the Freeway.

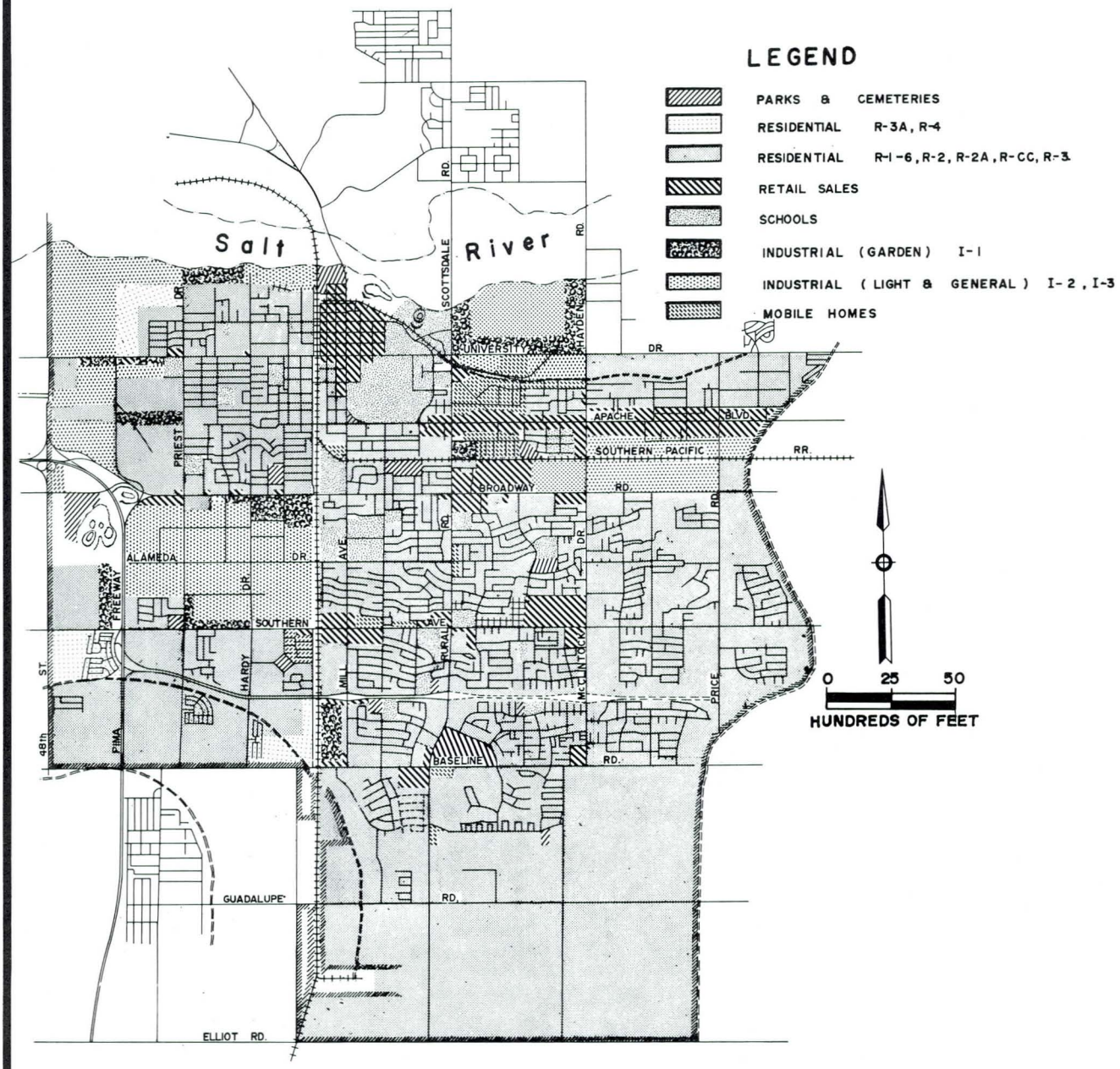
Section 3

ANALYSIS

The rational method was used to estimate the runoff quantities. The rational 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 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.

The drainage area has been subdivided into smaller drainage areas in order to make more detailed estimates of runoff quantities. The use of smaller drainage areas reduces the possibility of overlooking local problems and allows strategic location of inlets and other drainage structures. Plates 8, 9, and 10 in the Appendix indicate the manner of subdividing the drainage area.

The runoff factor C was obtained by an analysis of field data and current zoning data. Plate 3 indicates the current zoning. As a result of this analysis the following weighted C factors were developed.



ZONING MAP

STORM DRAINAGE REPORT

TEMPE, ARIZONA

Type of Development		C Factor
R-1 through R-3	Residential	0.35
R-1 through R-3	Residential Irrigated yards	0.20
R-3-A	Multi-family	0.54
R-4, R-5	Multi-family	0.67
RMH	Mobile home	0.54
C-1 through C-3, PSC-1, & PSC-2	Commercial	0.70
I-1	Industrial	0.31
I-2 & I-3	Industrial	0.63

Schools were given a C factor of 0.0 because they maintain extremely high borders for irrigation and will contain storms of higher magnitude than those considered in this Report.

The Arizona State University farm between the Southern Pacific Co. Railroad on the west, College Avenue on the east, McKemy School on the north, and Alameda Drive on the south was given a C factor of 0.05 because it is maintained as farm land at the present time and is considered to retain practically the entire rainfall. However, in the event the University changes their land use, the City should prevail upon the University to retain their storm runoff to prevent flooding of the area to the north.

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. Plate 15 in the Appendix shows the interpolation of rainfall depth and the two and five-year rainfall intensity duration curves.

Initial drainage areas were established at the highest point of the overall drainage area. In most instances these initial areas were in

developed areas with the streets being the conduits conducting the storm water to the first storm inlet. In instances where the initial area was undeveloped, an area suitable to the terrain and zoning was chosen. Plate 16 in the Appendix indicates the method used to establish the initial time of concentration.

The return frequencies for this Report are two-year and five-year design storms as set forth in the Contract.

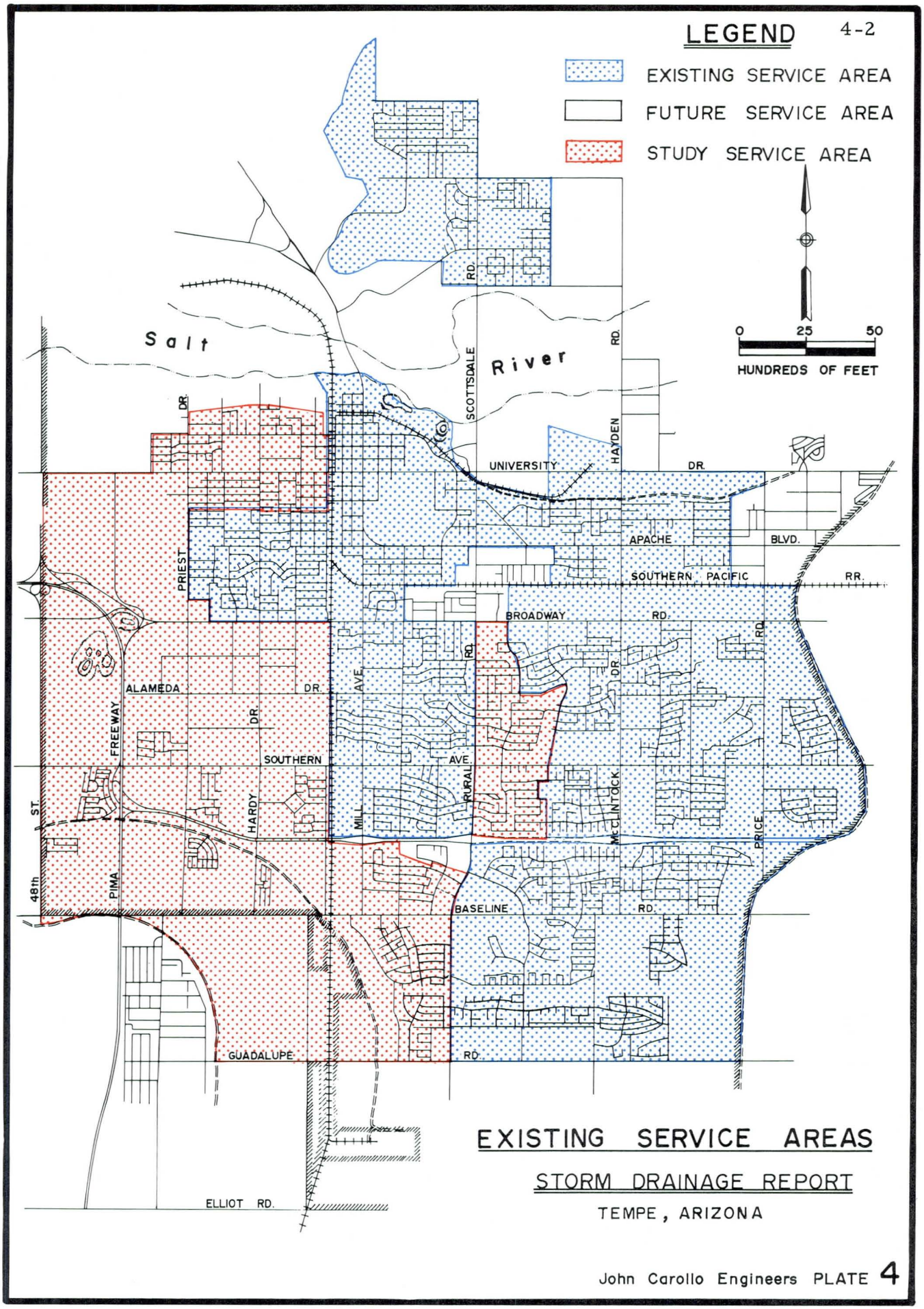
Section 4

EXISTING STORM DRAIN FACILITIES

The City of Tempe storm drain system has expanded rapidly over the past twelve years. Tempe by comparison has kept abreast or surpassed its neighboring cities in storm sewer service in its community. Plate 4 indicates both the areas of the City now being served and that portion being considered in this study. Plate 5 indicates all existing storm drains. Many of the early day storm systems served a dual purpose. They were first irrigation mains and secondly storm drains and generally functioned in this manner. This is still true in many areas and should remain intact when relief is afforded to serve as additional insurance. The combination irrigation storm sewer type conduits have been omitted from Plate 5 because they are not primarily storm sewer conduits and could be carrying irrigation water during a storm.

During the investigation of existing facilities a number of problem areas became evident, and it was discovered that these areas were not in the scope of this Report. The first of these areas is between Apache Boulevard on the north, the railroad on the south, the abandoned railroad right-of-way on the east, and Rural Road on the west. The drainage is to the west in Spence Avenue to two catch basins at Rural Road. The storm water is then carried in an 18-inch pipe south to the south side of the railroad, then west to a waste ditch along the south side of the railroad right-of-way to McAllister Avenue, then north to George ditch.

The second of these areas is between the railroad on the north, Broadway on the south, Terrace Road on the east, and Ventura Drive on

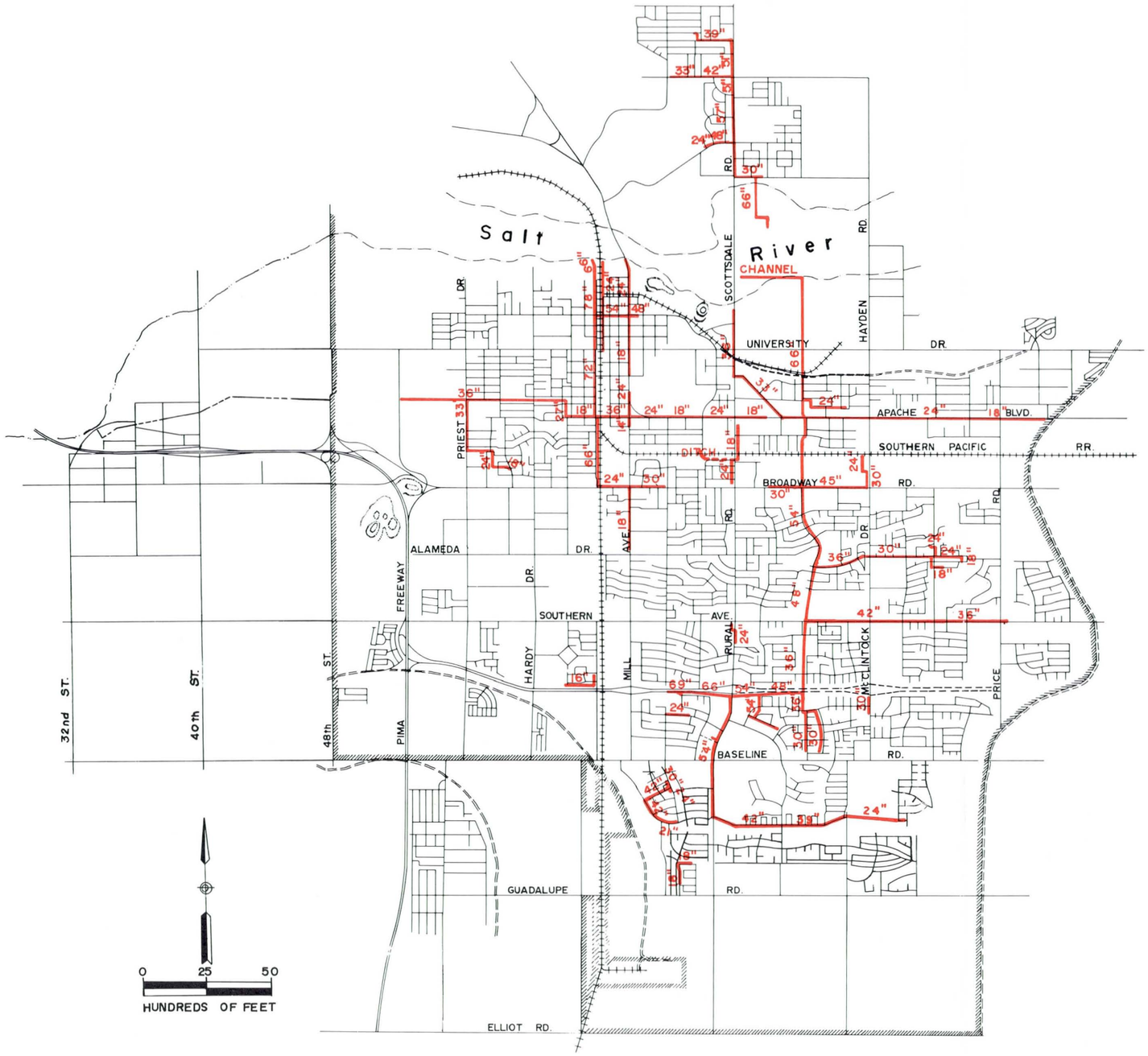


EXISTING SERVICE AREAS

STORM DRAINAGE REPORT

TEMPE, ARIZONA

John Carollo Engineers PLATE 4



LEGEND

36" EXISTING PIPE & SIZE

EXISTING DRAINAGE SYSTEM

STORM DRAINAGE REPORT

TEMPE, ARIZONA

the west. This area is divided by Rural Road which stops drainage to the west from Terrace Road. Several catch basins along Rural Road allow some storm water to enter a 24-inch pipe flowing north on the west side of Rural Road and discharge into the same waste ditch that the Spence Avenue storm flows into. The area west of Rural Road, with the exception of the east half of Vista Del Cerro Drive, drains to the intersection of Ventura Drive and Vista Del Cerro Drive and enters a curb inlet, then through an 18-inch pipe into the same waste ditch serving the Spence Avenue and the area east of Rural Road. The east half of Vista Del Cerro Drive drains east to a 24-inch pipe flowing north along Rural Road, thence to the common waste ditch along the railroad.

A preliminary analysis indicates that each of these areas does not have adequate facilities to dispose of the design storm. It is evident that some property damage may occur along Rural Road, the west end of Spence Avenue, and at the intersection of Vista Del Cerro Drive and Ventura Drive.

Section 5

PROPOSED IMPROVEMENTS

The continued rapid growth to the west and south section of Tempe has exceeded the capacity of the existing facilities.

The proposed plan for expanding and extending the storm drain system has been developed to be constructed in five phases. These phases are planned to meet presently developed area needs and to meet future drainage demands as dictated by future industrial and residential growth.

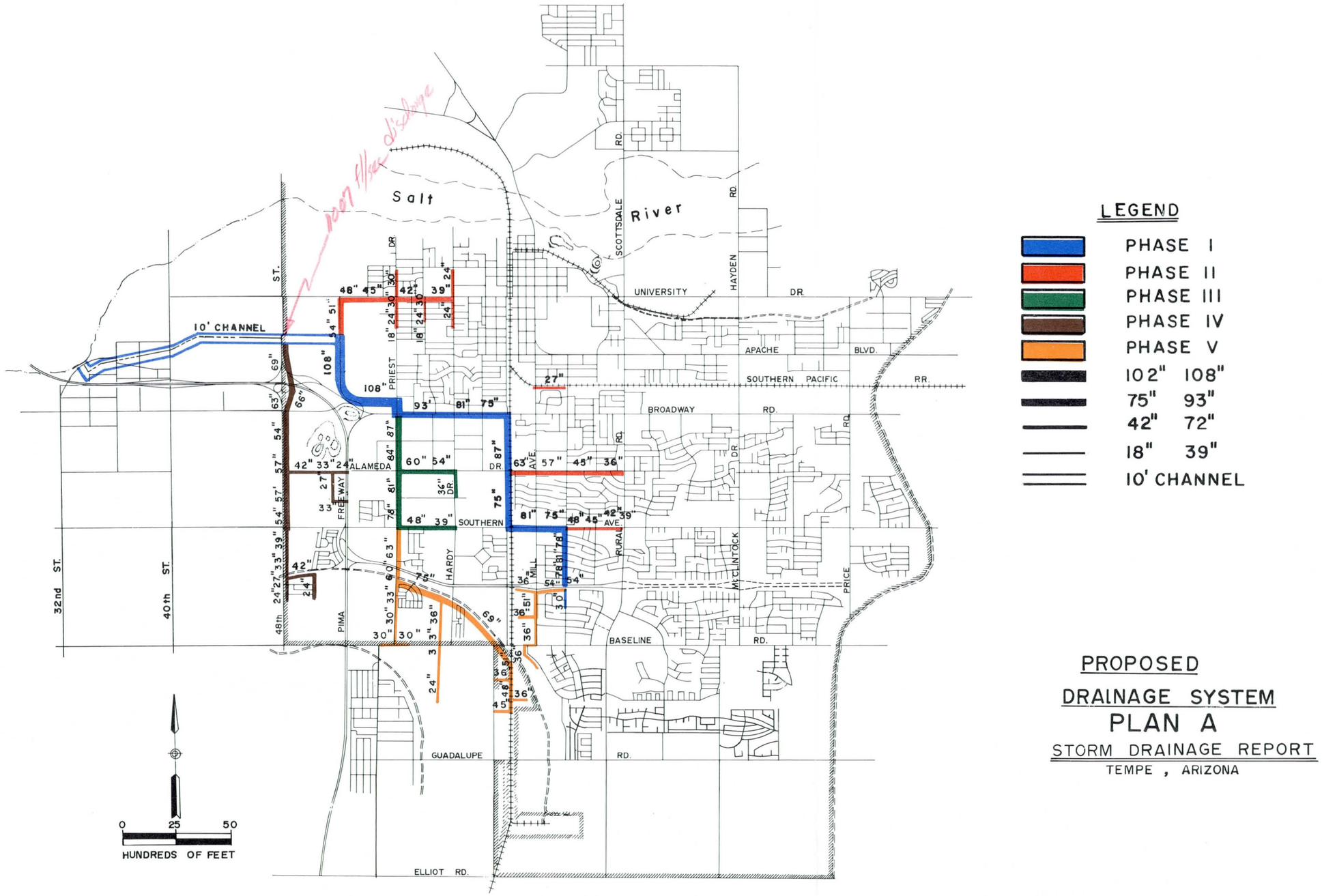
PHASE I

Phase I has been divided into Plan A and Plan B. This phase represents the main trunk or trunks that serve the entire system. The construction of Phase I is quite extensive and extends to areas beyond the limits of the City boundary, discharging 1,110 feet per second of water into the Salt River between 33rd and 34th Streets in Phoenix.

The City of Tempe and the Arizona Highway Department are negotiating an agreement to jointly share the use of their respective facilities. Because an agreement has not been reached at the time of publication of this Report, we have developed Plan A to be implemented in the event an agreement is not reached with the Highway Department, and Plan B was developed to include joint use of respective facilities.

PLAN A - PHASE I (Plate 6A) begins on College Avenue (College Avenue lateral) at the Superstition Freeway.

The City of Tempe is constructing a storm sewer on the south side of the Freeway beginning at College Avenue and extending east to Dorsey Lane. The City is delivering a Q (maximum rate of runoff) equal to 123 feet



PROPOSED

DRAINAGE SYSTEM

PLAN A

STORM DRAINAGE REPORT

TEMPE , ARIZONA

per second with a time of concentration equal to 78 minutes through an existing 69-inch pipe under the Freeway at College Avenue.

In addition to the present construction, storm flow from (Mill Avenue lateral) southeast of the Freeway and College Avenue is included in the present design.

The college Avenue trunk continues along College Avenue to Southern Avenue intercepting flow from intermediate streets.

At Southern Avenue the Southern Avenue lateral is intercepted and the trunk continues to the east side of the Southern Pacific Co. Railroad where the trunk continues north to Alameda Drive where storm flow from the Alameda Drive lateral is intercepted. The trunk then continues to Broadway Road where it intercepts storm flow from the Broadway Road lateral. At this point a portion of the storm flow (140 cubic feet per second) will be diverted into the existing (Farmer Avenue trunk) main. The College Avenue trunk continues to the west, intercepting surface flow at intercepting streets, to Priest Drive where it intercepts storm flows from Priest Drive lateral. The trunk continues to the north to a point just north of the Jenkins ditch and follows the north bank of ditch to 52nd Street, then north to the Tempe Drainage District No. 2 Ditch where the storm flow from the University Drive lateral is intercepted. The trunk continues in an open channel west to 48th Street where the storm flows from the 48th Street lateral are intercepted. The total storm flow will continue in the Tempe Drainage District No. 2 Ditch right-of-way to the Salt River at approximately 34th Street and the Freeway.

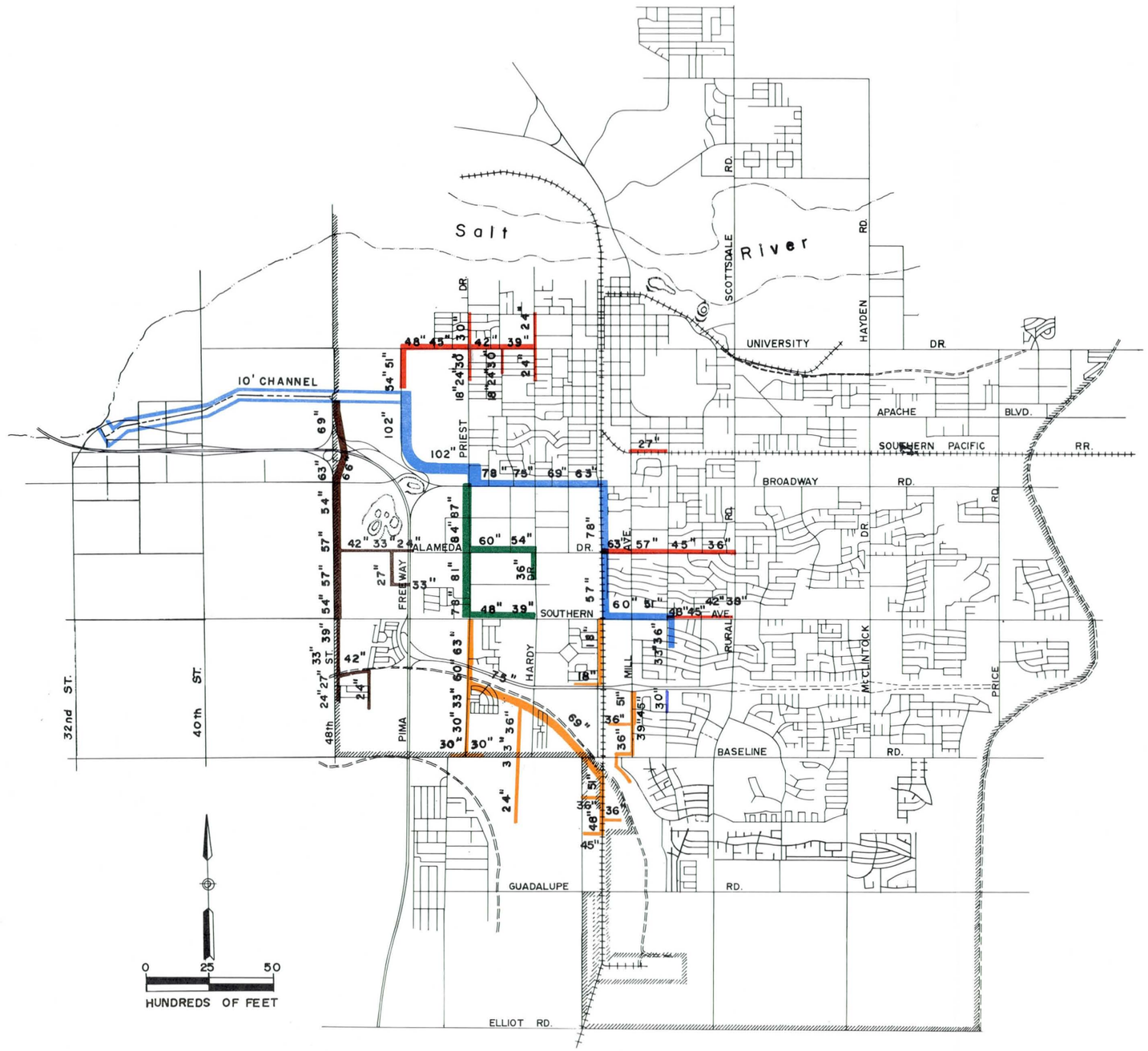
The channel improvement will require the reconstruction of new bridges at seven locations across the Tempe Drainage District No. 2 Ditch.

PLAN B - PHASE I (Plate 6B) begins on College Avenue at La Jolla Drive and continues to Southern Avenue. At this point the College Avenue trunk continues along the same route as Plan A. The basic difference in Plan B is defined as assuming that storm flow south of the Superstition Freeway will be intercepted by the Arizona Highway Department storm sewer (as described in Plan #5, pages 14, 15, and 16 of report entitled "Drainage Study of Superstition Freeway," Project F-028-1(2) Rural Road-Dobson Road; see Appendix page App B-1) and detained in a basin located between the Superstition Freeway on the Western Canal just east of Hardy Drive. The contents of the detention basin will be pumped to the College Avenue trunk through an 18-inch pressure main. The pressure main extends from the Freeway north to Southern Avenue at the Southern Pacific railroad. Automatic controls are recommended to actuate pumps the instant capacity becomes available in the storm sewer.

PHASE II

Phase II is common to both Plan A and Plan B of Phase I and consists of five laterals to the main trunk. Southern Avenue lateral is the first intercepted by the College Avenue trunk main at College and Southern Avenues, where the Southern Avenue lateral continues east to Rural Road. The lateral collects surface water at each street intersection.

The Alameda lateral is the second to be intercepted by the College Avenue trunk at Alameda Drive and Southern Pacific railroad, where the Alameda lateral continues east to Rural Road. The lateral collects surface water at each street intersection.



LEGEND

- PHASE I
- PHASE II
- PHASE III
- PHASE IV
- PHASE V
- 93"—102"
- 75"—87"
- 42"—72"
- 18"—39"
- 10' CHANNEL

PROPOSED DRAINAGE SYSTEM PLAN B

STORM DRAINAGE REPORT

TEMPE , ARIZONA

The Southern Pacific Company Railroad branch is a relief lateral replacing an existing irrigation conduit in the alley north of Vista Del Cerro Drive. This branch begins at Mill Avenue and continues east to the alley west of College Avenue, where a connection will be made to an existing storm drain for the Daley Park area.

The University lateral is the last lateral in Phase II. This lateral is intercepted by the College Avenue trunk at 52nd Street and the Tempe Drainage District No. 2 Ditch. The University lateral continues north to University Drive where it continues east to Hardy Drive. There are short branches extending north to 5th Street on Hardy Drive and south to 10th Street. Also a branch extends south on Beck Drive to 10th Street. There are two more branches on Priest Drive, one extending north to 5th Street and the other extending south to 10th Place. The surface water is collected and removed at each street intersection.

PHASE III

Phase III is common to both Plan A and Plan B of Phase I and consists of one lateral and its branches extending south on Priest Drive from Broadway. This lateral is called the Priest lateral and is divided into two sections at Southern Avenue and may be further subdivided should land development warrant such refinement. There are two branch mains, one at Alameda Drive extending east to Hardy Drive and continuing south on Hardy Drive to Fairmont Drive, and the second extends east on Southern to Hardy Drive. The surface water is removed at street intersections and a few intermediate locations.

There have been no provisions for storm water removal from the industrial park situated between the Freeway on the west, Priest Drive on the east, Broadway on the north, and Fairmont Drive on the south. This area drains to the northeast and is practically impossible to drain effectively. Therefore those industries developing in this area are being encouraged by the City Engineering personnel to retain on-site storm water by small lagoons or basins. The street drainage will be concentrated at Alameda Drive and the Freeway where a single 24-inch reinforced concrete pipe under the Freeway conducts storm water into an open ditch and, for the future, into a subbranch main constructed within the scope of Phase V.

PHASE IV

Phase IV is common to both Plan A and Plan B of Phase I and consists of one lateral and its branches extending south from the College Avenue trunk on 48th Street to the south side of the Western Canal, then east along the canal to Potter Road, then south to approximately 1,600 feet north of Baseline Road.

There are branch lines at Alameda Drive and the Western Canal south on 48th Street. The branch main at Alameda Drive extends east to the southeast corner of the baseball stadium, then south on Fairmont Drive extended, then east to the Freeway where a connection is made to two 24-inch reinforced concrete pipes under the Freeway. The local drainage from a subdivision situated just east of the Freeway to Priest Drive and north of Southern Avenue to Fairmont Drive is concentrated at the two

24-inch reinforced concrete pipes. At Alameda Drive at the baseball facility there is a subbranch extending east to a 24-inch reinforced concrete pipe under the Freeway. This 24-inch pipe intercepts street concentration within a new industrial park just east of the Freeway. This industrial park was mentioned previously under Phase III.

The branch main just south of the Western Canal extends south on 48th Street to a point at an alley south of Carson Drive. This main may have to be extended as development continues. At the present time it will remove storm water on 48th Street before it becomes a problem to the subdivision just adjacent to the main.

All surface runoff will be removed at intersections and other strategic locations

There will be extensive tunneling required at two points within the interchange area just north of Broadway. There will also be tunneling required at the Western Canal.

PHASE V

Phase V is common to both Plan A and Plan B of Phase I and is the southern portion of the Priest Drive lateral. This lateral extends south under the Freeway and Western Canal, continuing southeasterly along the south bank of the canal to Baseline, with branches at Priest Drive and the Western Canal, 2,000 plus or minus feet east of Priest Drive along the

east boundary of Guadalupe Cemetery, extending south along the railroad right-of-way beginning at Baseline.

The branch extending south along Priest Drive has two subbranches continuing both east and west on Baseline.

The branch extending south from the Western Canal at a point 2,000 plus or minus feet east of Priest Drive continues to a point one-half mile south of Baseline.

The branch extending south at Baseline and the railroad has three subbranches, each serving points of concentration.

The Mill Avenue lateral under Plan A, Phase I begins at the Freeway and College Avenue, continues west along the south side of the Freeway to Mill Avenue, then south to Ellis Drive. There are branches west of Mill Avenue at the Freeway and one-quarter mile south of the Freeway.

In addition to the above construction, the existing detention basin located just west of the intersection of Oxford Drive and Dartmouth Drive should have some modifications.

The present facility will adequately serve the area as it is presently developed. However, when this land is developed into a park, the detention basin should be modified to serve as a surge pond with a large depressed area to function as storm water storage to be released at a reduced rate through a gravity pipe extending to the Mill Avenue lateral at Ellis Drive. The overflow pipe serves as a safety valve and delays the peak runoff time for this area to a time when the main system is well beyond its peak flow time.

Under Plan B the Mill Avenue lateral is modified to be compatible with Plan #5, Arizona Highway Department (see Appendix App B-1). The

Mill Avenue lateral will terminate at a junction with the State storm sewer. The City will have to get permission from the State to discharge the overflow water from the detention basin at Oxford and Dartmouth Drives.

COMPLETED PROJECT

The construction phases have been arranged in an order that may best suit the present development and the estimated trend of future development.

It may be noted that some branch mains extend to the center of a field or to places of no apparent urban or commercial development. This means was used to arrive at a more realistic size for the laterals that intercept these branches. The locations are flexible and may be relocated to best serve future development.

Section 6

SUMMARY OF

IMPROVEMENTS AND ESTIMATED COSTS

The proposed improvements have been arranged in a manner that is estimated to meet the needs of several existing developments that have known drainage problems and to serve the needs of future improvements. The summary of estimated construction cost, as shown in Table 1, has been arranged to show the cost comparison between the two proposed plans.

The optional construction was proposed based on future development of Kiwanis Park. The use of an overflow would discharge excess water from a 25-year storm within 48 to 60 hours.

These construction costs are based upon current July 1972 rates. The summary includes the cost of engineering and administrative costs along with incidental costs. The costs have not been escalated because the total plan is not arranged in relation to time.

Table 1

SUMMARY OF ESTIMATED CONSTRUCTION COST

	Phase I		Phase II	Phase III	Phase IV	Phase V		Totals			
	Plan A	Plan B	Plan A or B	Plan A or B	Plan A or B	Plan A	Plan B	Plan A Plus Option	Plan B Plus Option	Plan A Minus Option	Plan B Minus Option
	$	$	$	$	$	$	$	$	$	$	$
College Avenue Main	3,866,000	3,492,000						3,866,000	3,492,000	3,866,000	3,492,000
Southern Ave Lateral			173,000					173,000	173,000	173,000	173,000
Alameda Dr Lateral			381,000					381,000	381,000	381,000	381,000
SP Co RR Branch			43,000					43,000	43,000	43,000	43,000
University Dr Lateral			631,000					631,000	631,000	631,000	631,000
Priest Dr Lateral 1st one-half Project				931,000				931,000	931,000	931,000	931,000
48th St Lateral					1,221,000			1,221,000	1,221,000	1,221,000	1,221,000
Priest Dr Lateral 2nd one-half Project						1,320,000	1,320,000	1,320,000	1,320,000	1,320,000	1,320,000
Mill Ave Lateral						329,000	207,000	329,000	207,000	329,000	207,000
Option (Same, Plan A or B) Basin overflow at Oxford & Dartmouth						100,000	100,000	100,000	100,000		
18" Pressure Main							134,000		134,000		134,000
Total Construction Cost*	3,866,000	3,492,000	1,228,000	931,000	1,221,000	1,749,000	1,761,000	8,995,000	8,633,000	8,895,000	8,533,000
Engineering, Administration, etc 18%	696,000	629,000	221,000	167,000	220,000	315,000	317,000	1,619,000	1,554,000	1,601,000	1,536,000
Total Project Cost	$4,562,000	$4,121,000	$1,449,000	$1,098,000	$1,441,000	$2,064,000	$2,078,000	$10,614,000	$10,187,000	$10,496,000	$10,069,000

Note:

Costs based on July 1972 prices.

For construction quantities and costs see Appendix A pages A-32 through A-37.

* Rounded to nearest $1,000.

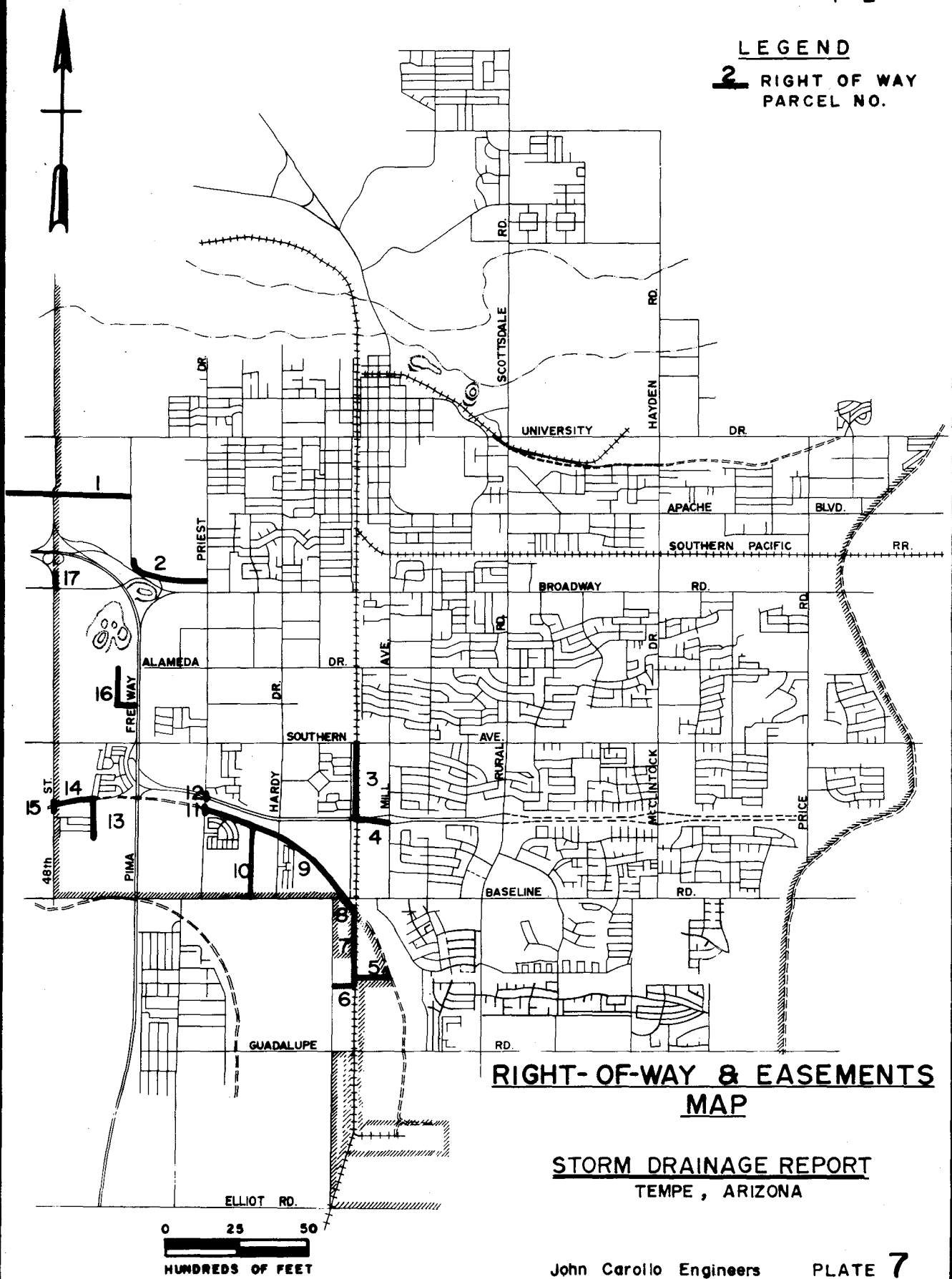
Section 7

RIGHTS - OF - WAY

The right-of-way acquisition for this Report will be limited to special problems of crossing public utilities and services. The major portion of the project is located within public rights-of-way or will be when construction is authorized. The following list of easements or rights-of-way are identified by numbers to be found on Plate 7.

Parcel No.	Length ± Lin Ft	Width* Feet	Owner (Last of Record)
1-1	16,300	70	Salt River Project
2-1	413	15	State of Arizona
2-2	880	15	Frances M. Cocke
2-3	1,312	15	Frances M. Cocke, First National Bank, James Stewart Company
3-1	2,640	15	Southern Pacific Co. Railroad
4-1	912	15	Stanley K. Sheinbaum
4-2	290	15	Hazel Fisher
5-1	911	15	Midland-Ross Corporation
6-1	624	15	Midland-Ross Corporation
7-1	624	15	Community Gin Company
7-2	2,640	15	Southern Pacific Co. Railroad
8-1	209	15	Benjiman O. Kappelmann
8-2	141	15	Benjiman O. Kappelmann
8-3	332	15	S. L. & Joyce M. Jennings et al
8-4	30	15	Community Gin Company
9-1	805	15	Milton & Margret Goldman
9-2	520	15	Joe Bob & Margret Edna Neely
9-3	1,410	15	Stewart Title & Trust Co. 1383
9-4	769	15	Canlen Park Investments
9-5	1,721	15	Colwell Management Company
9-6	117	15	Unknown
9-7	262	15	Bessie M. Moore, Mary Duncan
10-1	728	10	Stewart Title & Trust 1383
10-2	396	10	Roman Catholic Church, Phoenix Lady of Mt. Carmel
10-3	1,287	10	Stewart Title & Trust 1383
11-1	100	15	Salt River Project
12-1	300	15	State of Arizona

* All easements require a temporary 10-foot working or construction easement except Tempe Drainage District No. 2 Ditch



RIGHT-OF-WAY & EASEMENTS MAP

STORM DRAINAGE REPORT

TEMPE, ARIZONA

John Carollo Engineers PLATE 7

Parcel No.	Length ± Lin Ft	Width* Feet	Owner (Last of Record)
13-1	660	10	Charles Whetmore
14-1	1,500	15	Transamerica Title
15-1	100	15	Salt River Project
16-1	1,780	10	William R. & Helen F. Hubbard et al
17-1	559	15	CKW Joint Venture

* All easements require a temporary 10-foot working or construction easement except Tempe Drainage District No. 2 Ditch

Section 8

CONCLUSIONS AND RECOMMENDATIONS

The phenomenal urbanization of the outer reaches of the City of Tempe has increased the incidence of flooding on a broad scale. Where before, scattered development contained local flood problems within the confines of its individual improvement, now with the more concentrated development where it is difficult to distinguish one subdivision from another, we find the local flooding problem jumping its bounds and becoming a larger problem at the next point of concentration.

This accelerated growth for southern and western sections of Tempe point up the need for a comprehensive storm drain plan. This plan should be continually reassessed and updated to provide ultimate service to the public.

We recommend that the City of Tempe adopt the storm drain plan as described in this Report. The proposed plan has two alternatives that are dependent upon an agreement with the Arizona Highway Department.

We recommend that the City of Tempe encourage the industrial development located between Priest Road and the Freeway and south of Broadway Road contain all runoff within their own grounds and possibly release at convenient times through the 24-inch conduits under the Freeway at Alameda Drive and Fairmont Drive.

We recommend that the City of Tempe urge Arizona State University to plan on containing all on-site rainfall within the property at the University Farm located north of Alameda Drive between the railroad and College Avenue.

Section 9

ALTERNATE TO PLAN B

The City of Tempe and the Arizona Highway Department are presently negotiating toward a joint use facility. The State utilizes a detention basin to contain peak runoff from high intensity storms as well as storms with moderate intensity of long duration. The basin receives runoff from the Superstition Freeway between Rural Road and Priest Drive.

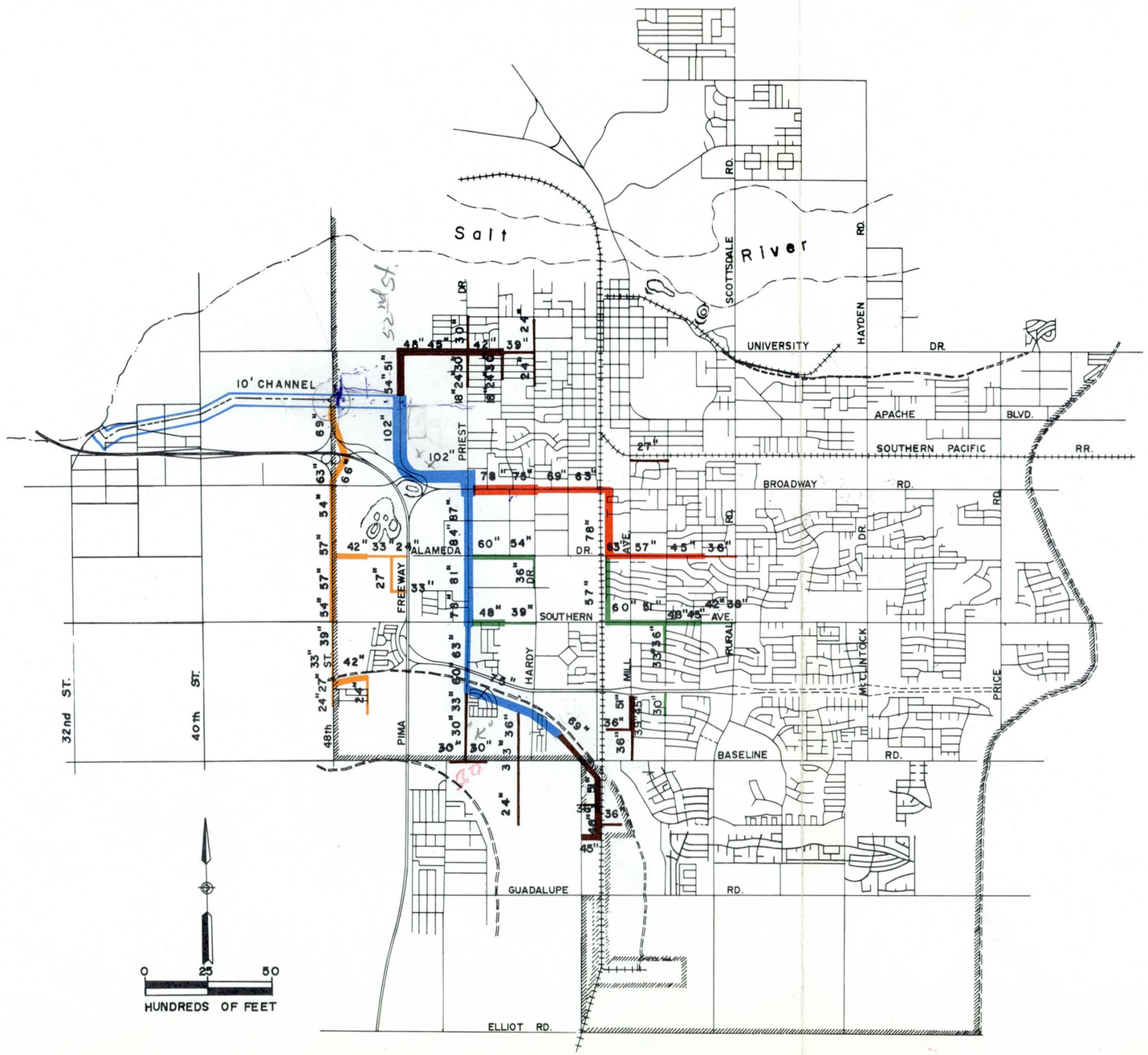
The basin contents are presently discharged into the Western Canal at the rate of one cubic foot per second.

Under the joint use plan the State would be able to discharge stored water at greater flow rates. The detention time would be reduced, and the discharge pumping could be programmed to begin immediately as capacity in the joint use main becomes available.

The following alternate plan is a result of conferences among City, State, and John Carollo Engineers personnel concerning a joint use storm drain facility.

PHASE I

Alternate to Plan B (Plate 6 C) begins at a point on the south side of the Western Canal opposite the State detention basin. The storm drain continues along the south side of the Western Canal to Priest Drive, where the storm drain continues north along Priest Drive to Broadway Road. Here the storm drain intercepts the College Avenue trunk and continues north to a point just north of the Jenkins Ditch and follows the north bank of the ditch to 52nd Street, then north to the Tempe Drainage District No. 2 Ditch. At



LEGEND

- PHASE I
- PHASE II
- PHASE III
- PHASE IV
- PHASE V
- 93"—102"
- 75"—87"
- 42"—72"
- 18"—39"
- 10' CHANNEL

PROPOSED DRAINAGE SYSTEM

ALTERNATE TO PLAN B

STORM DRAINAGE REPORT

TEMPE , ARIZONA

John Carollo Engineers

PLATE 6C

this point the flow enters an open channel to the west, continuing west to approximately 34th Street where the flow is discharged into the Salt River.

The channel should be improved as additional laterals and branches are constructed.

PHASE II

Alternate to Plan B (Plate 6 C) begins at Rural Road and Alameda Drive and continues west along Alameda Drive to the South Pacific Company Railroad where the lateral is intercepted by the College Avenue trunk. Then flow continues north along the railroad to Broadway Road where flow is intercepted by the Broadway lateral. The College trunk continues west along Broadway Road to where the trunk is intercepted by the Priest main.

PHASE III

Alternate to Plan B (Plate 6 C) the College Avenue trunk begins at La Jolla Drive on College Avenue and continues north to Southern Avenue where this main intercepts the Southern Avenue lateral.

The College Avenue trunk continues west along Southern Avenue to the Southern Pacific Company Railroad where the main continues north along the railroad to Alameda Drive where the main connects to Phase II construction.

In addition to the College Avenue trunk there are the Southern Avenue lateral and two branches to the Priest lateral.

The Southern Avenue lateral begins at Rural Road and Southern Avenue and continues west to College Avenue where the lateral connects to the College Avenue trunk.

The two-branch main connects to the Priest Road lateral. The first branch beginning at Hardy Drive and Southern Avenue continues west to the Phase I construction. The second branch begins at Fairmont Drive and Hardy Drive and continues north to Alameda Drive and then continues west to the Phase I construction.

PHASE IV

Alternate to Plan B (Plate 6 C) consists of the completion of the Priest lateral, beginning at a point on Kyrene Drive one-half mile south of Baseline Road and continuing east to the Southern Pacific Company Railroad, then north along the railroad to the south bank of the Western Canal where the lateral continues northwesterly along the south side of the Western Canal to where a connection is made to the Phase I main.

Two additional branches to the Priest Road lateral are to be constructed in this Phase IV. The first begins one-half mile south of Baseline Road at a point one-half mile east of Priest Drive and continues north to south of the Western Canal where a connection is made to the Phase I main. The second branch begins at Baseline Road on Priest Drive and continues north to the Western Canal where the branch connects to Phase I construction.

In addition to the above there are three laterals to be included in Phase IV.

The first is the Mill Avenue lateral which begins at Baseline Road on Mill Avenue and continues north to intersect the State Highway storm drain.

The second is the Railroad lateral beginning at the alley west of College Avenue in the alley south of the Southern Pacific Company Railroad and continues west to the Mill Avenue underpass storm drain.

The third is the University lateral which begins at Fifth Street and Hardy Drive continuing south to University Drive and west along University Drive to 52nd Street, then south to intersect with Phase I construction.

There are four short branches to the University lateral. The first begins at 10th Street on Hardy Drive and continues north to University Drive and connects to University lateral. The second branch begins at 10th Street on Beck Avenue and continues north to connect with the University lateral. The third branch begins at 10th Street on Priest Drive and continues north to connect to the University lateral. The fourth branch begins at Fifth Street on Priest Drive and continues south to connect to the University lateral.

The following summary indicates the construction and total project costs for this Alternate to Plan B.

SUMMARY OF ESTIMATED CONSTRUCTION COST

ALTERNATE PLAN B

	Phase I	Phase II	Phase III	Phase IV	Phase V	Total
	$	$	$	$	$	$
College Ave Main (portion) Priest Lateral south to State Detention Basin	3,414,000					3,414,000
College Ave Main east & south to Alameda Dr		722,000				722,000
Alameda Lateral		381,000				381,000
College Ave Main from Alameda south to Southern Ave & east to College Ave			812,000			812,000
Southern Lateral			173,000			173,000
Priest Lateral (south portion) & Priest branches				795,000		795,000
Railroad Lateral				43,000		43,000
University Drive Lateral				631,000		631,000
Mill Ave Lateral				207,000		207,000
48th St Lateral					1,221,000	1,221,000
Total Construction Cost* (Based on July 1972 prices)	3,414,000	1,103,000	985,000	1,676,000	1,221,000	8,399,000
Engineering, Administration, etc. 18%	614,000	199,000	177,000	302,000	220,000	1,512,000
Total Project Cost	$4,028,000	$1,302,000	$1,162,000	$1,978,000	$1,441,000	$9,911,000

where is cost for 10' tunnel?

* Rounded to nearest $1,000.

APPENDIX A

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, Public Road Administration.

4. "Estimated Return for Short Durations Precipitation in Arizona," Technical Memorandum WBTM WR-44, Oct. 1969; Weather Bureau Western Region

5. "Zoning Map," Jan. 1972; City of Tempe

6. "Los Angeles Storm Drain Design Plates," Los Angeles County Engineers Office

7. "Topographical Maps," Oct. 1965; City of Tempe Planning Department

8. "As-Built Plans of City Storm Drains," City of Tempe Engineering Department

9. USGS 15-foot Quadrangles for Tempe and Guadalupe

10. "Drainage Study of the Superstition Freeway," Project F-028-1(2) Rural Road - Dobson Road; Structures Section, Arizona Highway Department

CRITERIA

1. Use Rational Method in accordance with reference No. 1
2. Use 2-year and 5-year return frequency.
3. Use Los Angeles County Standard Dd-30 for computing time of concentration for initial areas.
4. Initial areas in undeveloped sections shall be chosen to be of similar shape and area to those of developed subdivisions.
5. Maintain the hydraulic gradient at 4 to 6 inches above the upper inside face of the conduit.
6. Use an initial flow of Q = 123 cfs and time of concentration of T_c = 78 minutes at Freeway and College Avenue. (Data from City Project No. 71009)

ESTIMATE OF RUNOFF AND COST

GENERAL

Rainfall intensity-duration is established from Precipitation Maps A, B, C, and D, Plates 11 through 14 (pages 37a, 37b, 37c, & 37d, Reference No. 1). Plate 15 indicates the values for the 2-year and the 5-year frequency. These values are verified approximately on page 37 of Reference No. 4.

The intensity-duration curves for 2-year and 5-year return frequency were developed from pages 9, 10, 16, 17, 23, 24, 30, 31, 37, 38, 44, and 45 of Reference No. 1.

The area maps were developed from topographic maps, Reference No. 7. Plates No. 8, 9, and 10 indicate the subdivision of drainage areas. The area and runoff factors may be found on pages A-13 through A-26.

The time of concentration was established from Plate 16, Reference No. 6.

Pipe, street, and channel capacities were established from Plates 17 and 18 and from Table 2 in this section.

n is too low, unless lining conc is proposed
Recommend .022 (what
SRP uses)

The hydraulic properties of the outfall channel are as follows:

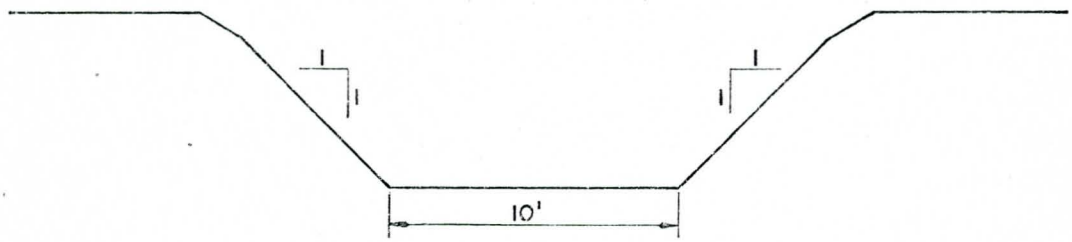


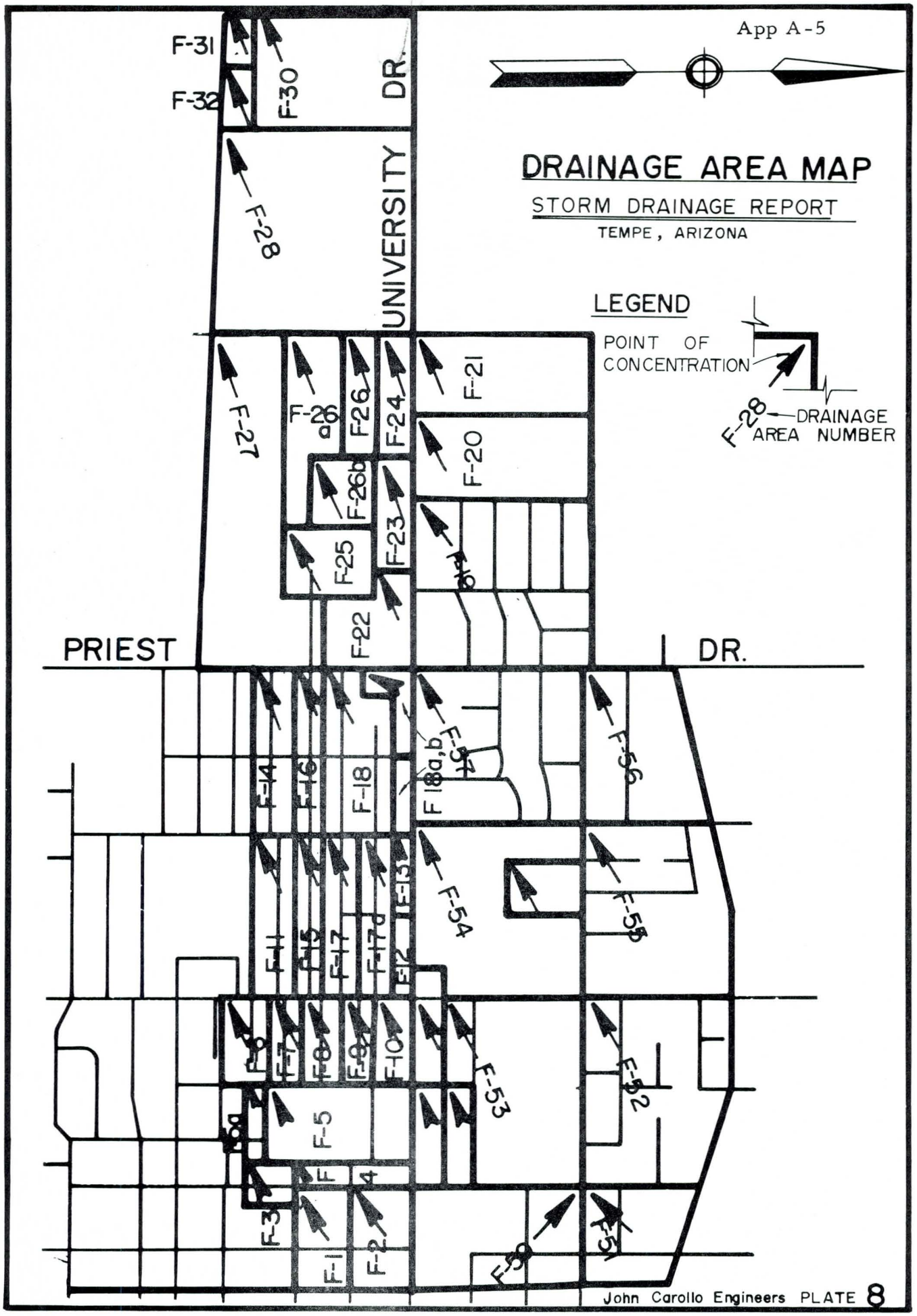
Table 2

HYDRAULIC PROPERTIES FOR 10-FOOT CHANNEL

n = 0.015

Depth Feet	Area Sq Ft	$Kr^{2/3}$	$Q/\sqrt{S}$
1	11.0	89.36	983
2	24.0	131.76	3,162
3	39.0	162.96	6,356
4	56.0	188.72	10,568
5	75.0	211.01	15,826
6	96.0	230.82	22,159
7	119.0	249.65	29,707
8	144.0	266.69	38,403
9	171.0	283.33	48,449
10	200.0	298.68	59,736

The curve of $Q/\sqrt{S}$ to depth when plotted approaches a straight line, therefore approximations by interpolation will be accurate.


DRAINAGE AREA MAP
STORM DRAINAGE REPORT
TEMPE, ARIZONA
LEGEND
POINT OF CONCENTRATION
F-28 DRAINAGE AREA NUMBER
UNIVERSITY DR.
PRIEST DR.
F-31
F-32
F-30
F-28
F-27
F-26a
F-26
F-24
F-21
F-20
F-26b
F-23
F-25
F-22
F-19
F-14
F-16
F-18
F-18a,b
F-57
F-56
F-11
F-15
F-17
F-17d
F-12
F-13
F-54
F-55
F-8
F-7
F-9
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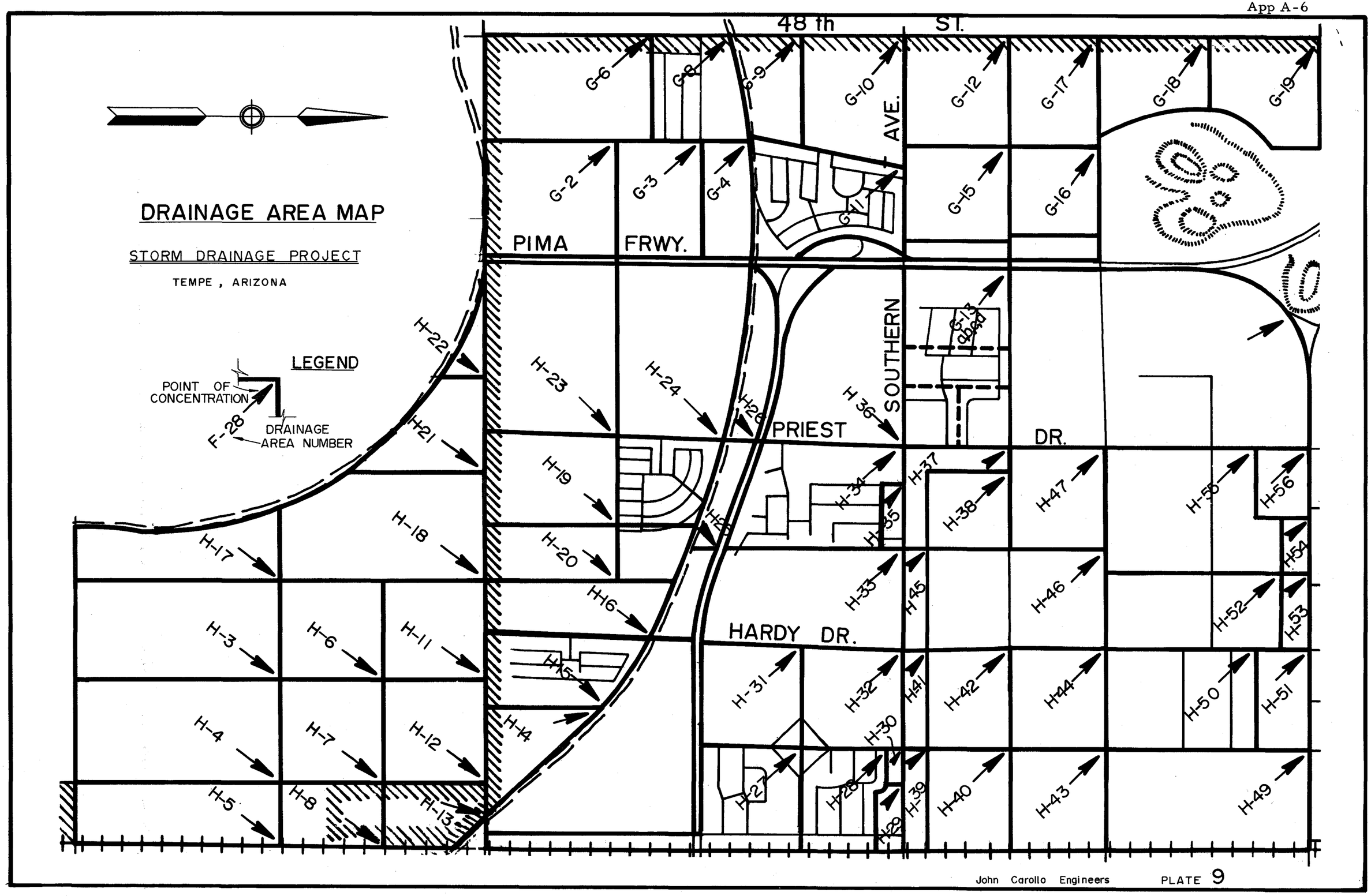
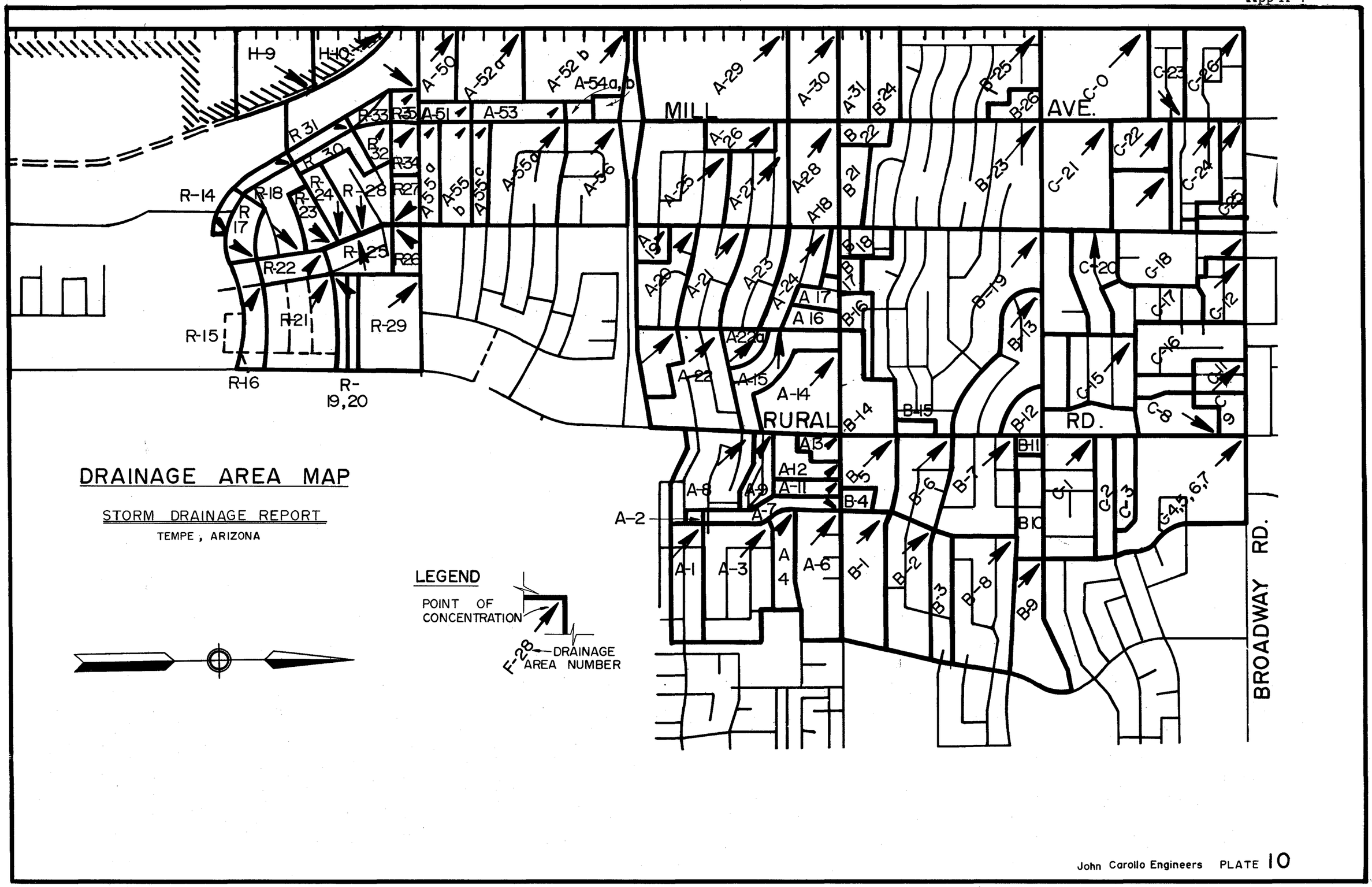
F-53
F-52
F-5
F-3
F-4
F-1
F-2
F-59
F-51



John Carollo Engineers PLATE 9


DRAINAGE AREA MAP
STORM DRAINAGE REPORT
TEMPE, ARIZONA
LEGEND
POINT OF CONCENTRATION
F-28 DRAINAGE AREA NUMBER
MILL AVE.
RURAL RD.
BROADWAY RD.
H-9
H-10
A-50
A-52 a
A-52 b
A-54 a, b
A-29
A-30
A-31
B-24
B-25
B-26
C-0
C-23
C-26
A-51
A-53
R-33
R-35
R-31
R-30
R-32
R-34
R-14
R-18
R-17
R-24
R-23
R-28
R-27
R-22
R-25
R-26
R-21
R-29
R-15
R-16
R-19,20
A-55 a
A-55 b
A-55 c
A-55 d
A-56
A-26
A-25
A-27
A-28
A-18
B-22
B-21
B-23
C-21
C-22
C-24
C-25
A-19
A-20
A-21
A-23
A-24
A 17
A 16
B-18
B-17
B-16
B-19
C-20
C-18
C-17
C-12
A-22a
A-22
A-15
A-14
B-14
B-15
B-13
B-12
C-16
C-15
C-11
C-8
C-9
A-13
A-12
A-11
A-8
A-9
A-7
A-2
B-5
B-4
B-6
B-7
B-11
B-10
C-1
C-2
C-3
C-4, 5, 6, 7
A-1
A-3
A 4
A-6
B-1
B-2
B-3
B-8
B-9

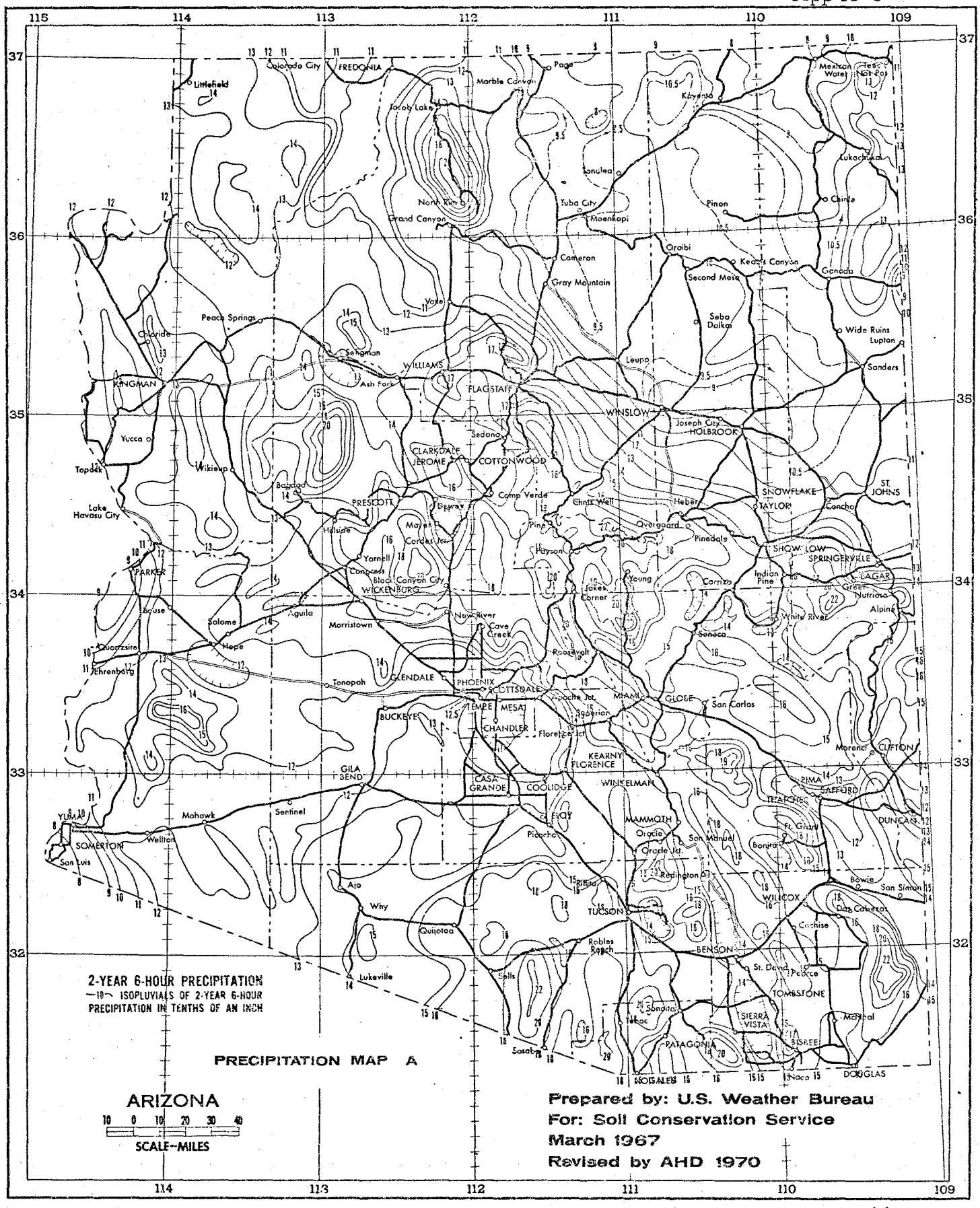

2-YEAR 6-HOUR PRECIPITATION
ISOPLUVIALS OF 2-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH
PRECIPITATION MAP A
ARIZONA
SCALE-MILES
Prepared by: U.S. Weather Bureau
For: Soil Conservation Service
March 1967
Revised by AHD 1970

PLATE 11

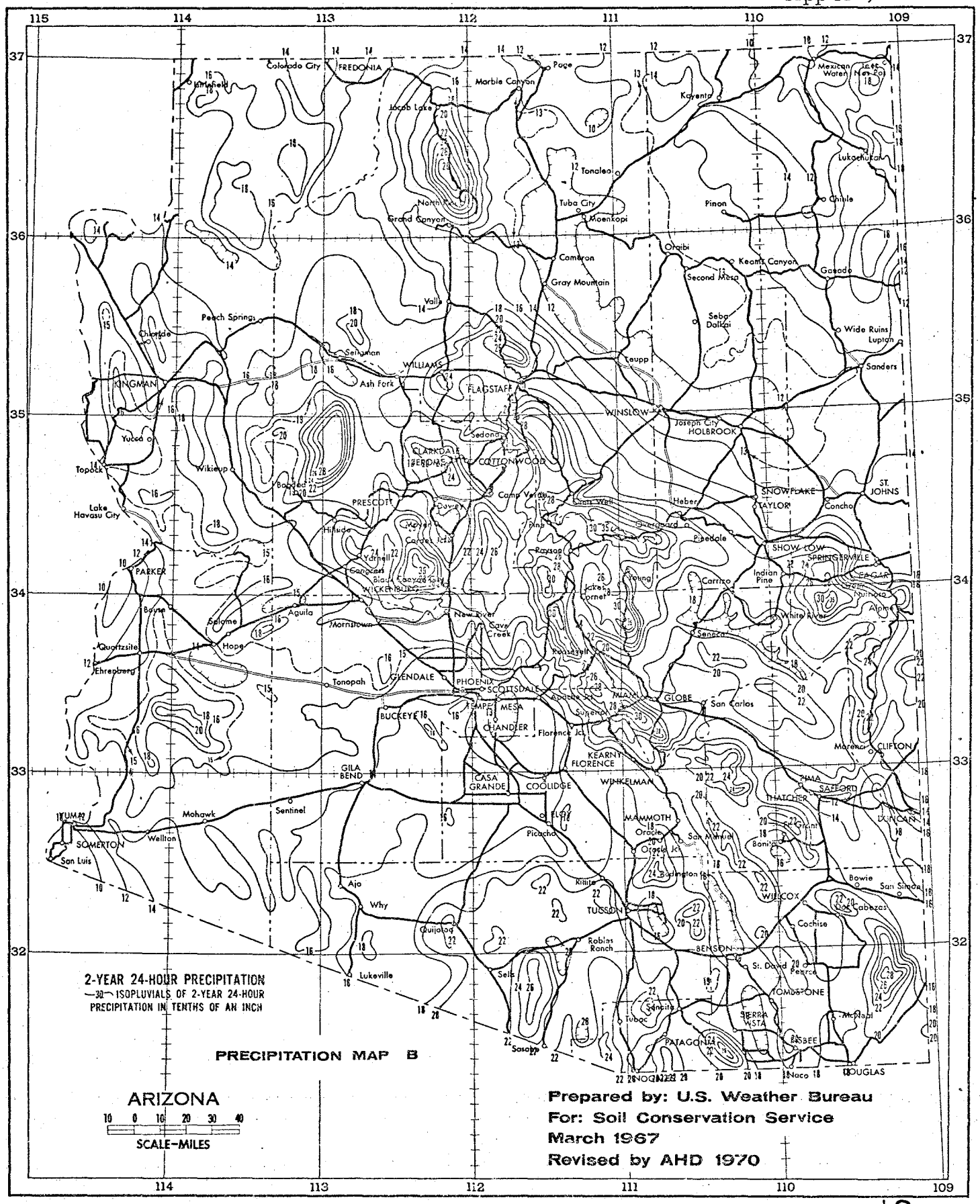

2-YEAR 24-HOUR PRECIPITATION
—30— ISOPLUVIALS OF 2-YEAR 24-HOUR PRECIPITATION IN TENTHS OF AN INCH
PRECIPITATION MAP B
ARIZONA
SCALE-MILES
Prepared by: U.S. Weather Bureau
For: Soil Conservation Service
March 1967
Revised by AHD 1970
Colorado City
FREDONIA
Page
Marble Canyon
Kayenta
Tonalea
Tuba City
Moenkopi
Pinon
Chinle
Lukachukai
Grand Canyon
Cameron
Oraibi
Keams Canyon
Second Mesa
Gallup
Gray Mountain
Valle
Seba Dalkai
Wide Ruins
Lupton
Sanders
Peach Springs
Chloride
Seligman
WILLIAMS
Ash Fork
FLAGSTAFF
KINGMAN
WINSLOW
Joseph City
HOLBROOK
Yucca
Topock
Wikieup
Sedona
CLARKDALE
JEROME
COTTONWOOD
Bagdad
Camp Verde
Cottonwood
Heber
SNOWFLAKE
TAYLOR
Concho
ST. JOHNS
Lake Havasu City
PRESCOTT
Dewey
Hillside
Prescott Jct
Pine
Overgard
Pinedale
Yarnell
Congress
Black Canyon City
WICKENBURG
Rayson
Young
Carrizo
Indian Pine
SHOW LOW
SPRINGERVILLE
EAGAR
Nutrioso
Alpine
PARKER
Bouse
Aguila
Salome
Morristown
New River
Cave Creek
White River
Quartzsite
Hope
Roosevelt
Seneca
Ehrenberg
Tonopah
GLENDALE
PHOENIX
SCOTTSDALE
Apache Jct
MIAMI
GLOBE
San Carlos
Superior
BUCKEYE
TEMPE
MESA
CHANDLER
Florence Jct
Morenci
CLIFTON
KEARNY
FLORENCE
GILA BEND
CASA GRANDE
COOLIDGE
WINKELMAN
ALMA
SAFFORD
THATCHER
YUMA
Mohawk
Sentinel
FLORENCE
Picacho
MAMMOTH
Oracle
San Manuel
Bonita
DUNCAN
SOMERTON
Wellton
San Luis
Aja
Why
Kirkland
Bowie
San Simon
WILCOX
Cabezas
TUCSON
Cochise
Quijotoa
Robles Ranch
BENSON
St. David
Pearce
Lukeville
Sells
TOMBSTONE
Sonoita
Tubac
SIERRA VISTA
McNeal
PATAGONIA
BISBEE
Sasabe
NOGALES
Naco
DOUGLAS

PLATE 12

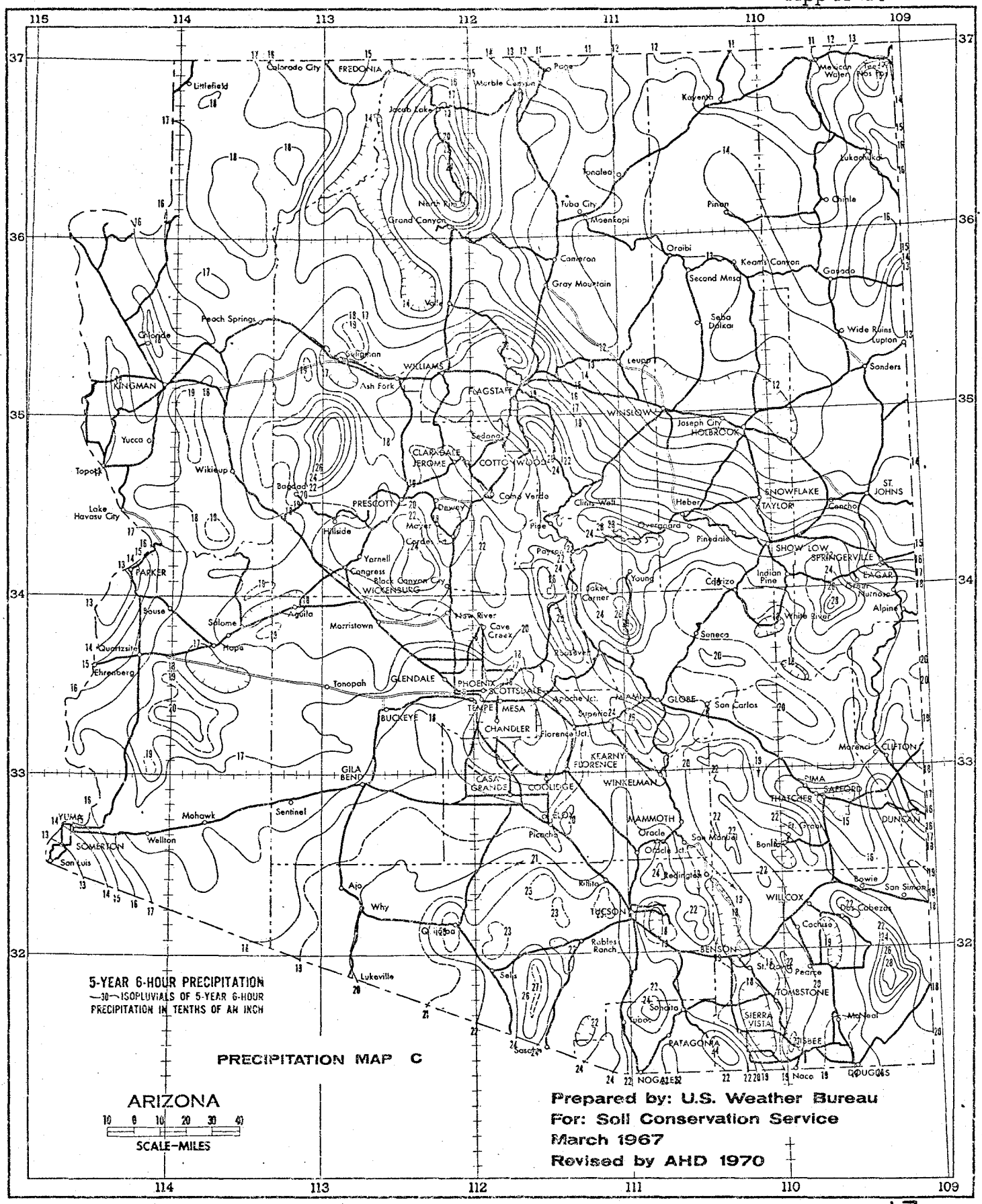
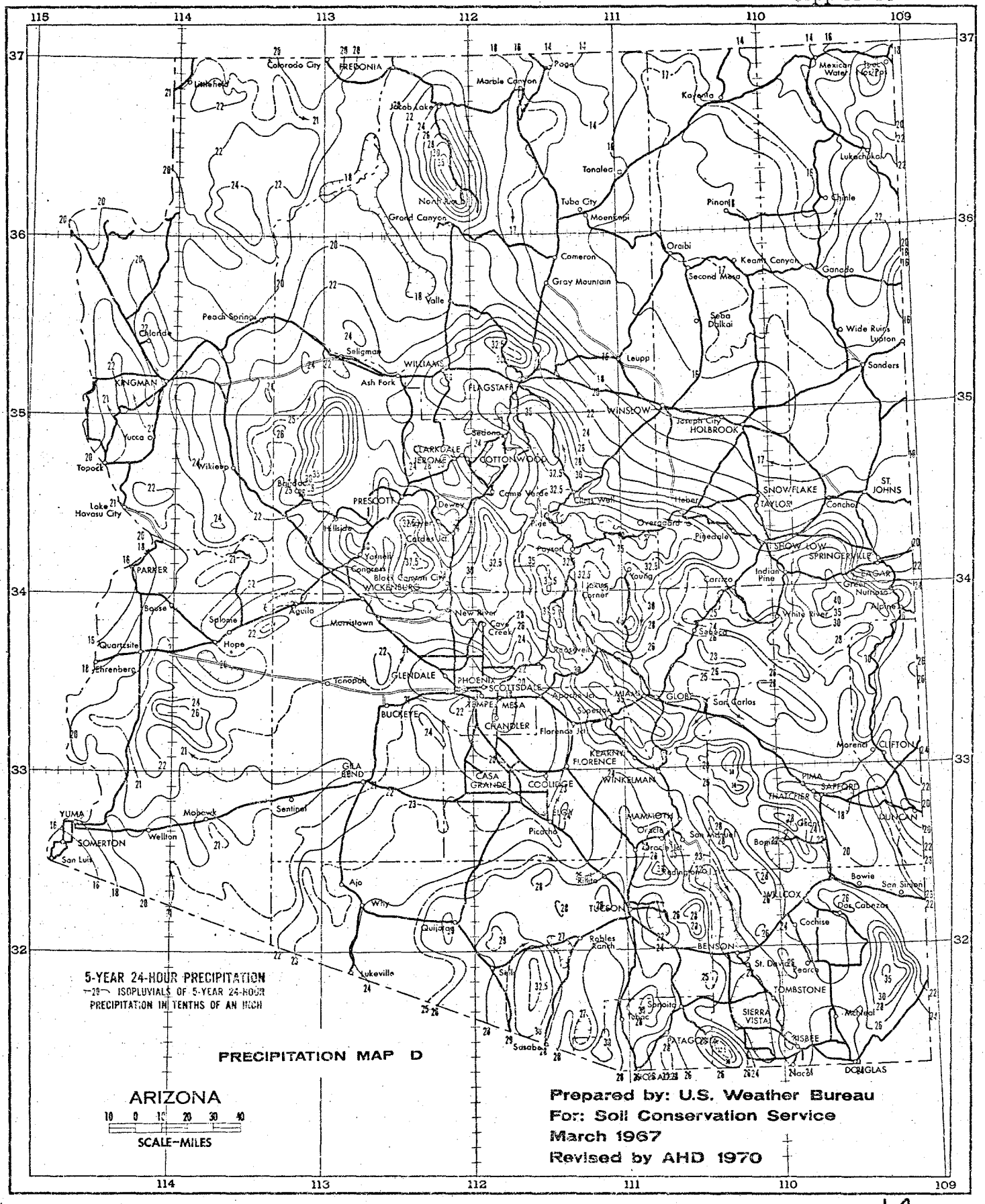

5-YEAR 6-HOUR PRECIPITATION
—30— ISOPLUVIALS OF 5-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH
PRECIPITATION MAP C
ARIZONA
SCALE-MILES
Prepared by: U.S. Weather Bureau
For: Soil Conservation Service
March 1967
Revised by AHD 1970
FREDONIA
Colorado City
Littlefield
Jacob Lake
Marble Canyon
Page
Kayenta
Mexican Water
Lukachukai
Tonalea
Tuba City
Moenkopi
North Rim
Grand Canyon
Pinon
Chinle
Cameron
Oraibi
Keams Canyon
Second Mesa
Gallup
Gray Mountain
Valle
Seba Dalkai
Wide Ruins
Lupton
Sanders
Peach Springs
Grandee
Seligman
WILLIAMS
Ash Fork
FLAGSTAFF
Leupp
KINGMAN
WINSLOW
Joseph City
HOLBROOK
Yucca
Sedona
CLARKDALE
JEROME
COTTONWOOD
Topock
Wikieup
Bagdad
Cottonwood
Cottonwood
Lake Havasu City
PRESCOTT
Dewey
Mayer
Cottonwood
Clints Well
Heber
SNOWFLAKE
TAYLOR
Concho
ST. JOHNS
Hillside
Pine
Overgaard
Pinedale
SHOW LOW
SPRINGERVILLE
EAGAR
PARKER
Yarnell
Congress
Black Canyon City
WICKENSBURG
Parker
Young
Cibrizo
Indian Pine
Nutrioso
Alpine
Bouse
Salome
Agua
Morristown
New River
Cave Creek
White River
Quartzsite
Hope
Roosevelt
Seneca
Ehrenberg
Tonopah
GLENDALE
PHOENIX
SCOTTSDALE
Apache Jct.
MIAMI
GLOBE
San Carlos
BUCKEYE
TEMPE
MESA
CHANDLER
Superior
Florence Jct.
Morenci
CLIFTON
KEARNY
FLORENCE
GILA BEND
CASA GRANDE
COOLIDGE
WINKELMAN
PIMA
SAFFORD
THATCHER
YUMA
Mohawk
Sentinel
ELOY
MAMMOTH
Oracle
San Manuel
DUNCAN
SOMERTON
Wellton
San Luis
Picacho
Oracle Jct.
Bonita
Redington
Bowie
San Simon
Ajo
Why
Kitt Peak
TUCSON
WILLCOX
Dos Cabezas
Cochise
Quitobaquito
Rubles Ranch
BENSON
St. David
Pearce
Lukeville
Sells
TOMBSTONE
Sonoita
Tubac
SIERRA VISTA
McNeal
PATAGONIA
TISBEE
Sasabe
NOGALES
Naco
DOUGLAS

PLATE 13


5-YEAR 24-HOUR PRECIPITATION
ISOPLUVIALS OF 5-YEAR 24-HOUR PRECIPITATION IN TENTHS OF AN INCH
PRECIPITATION MAP D
ARIZONA
SCALE-MILES
Prepared by: U.S. Weather Bureau
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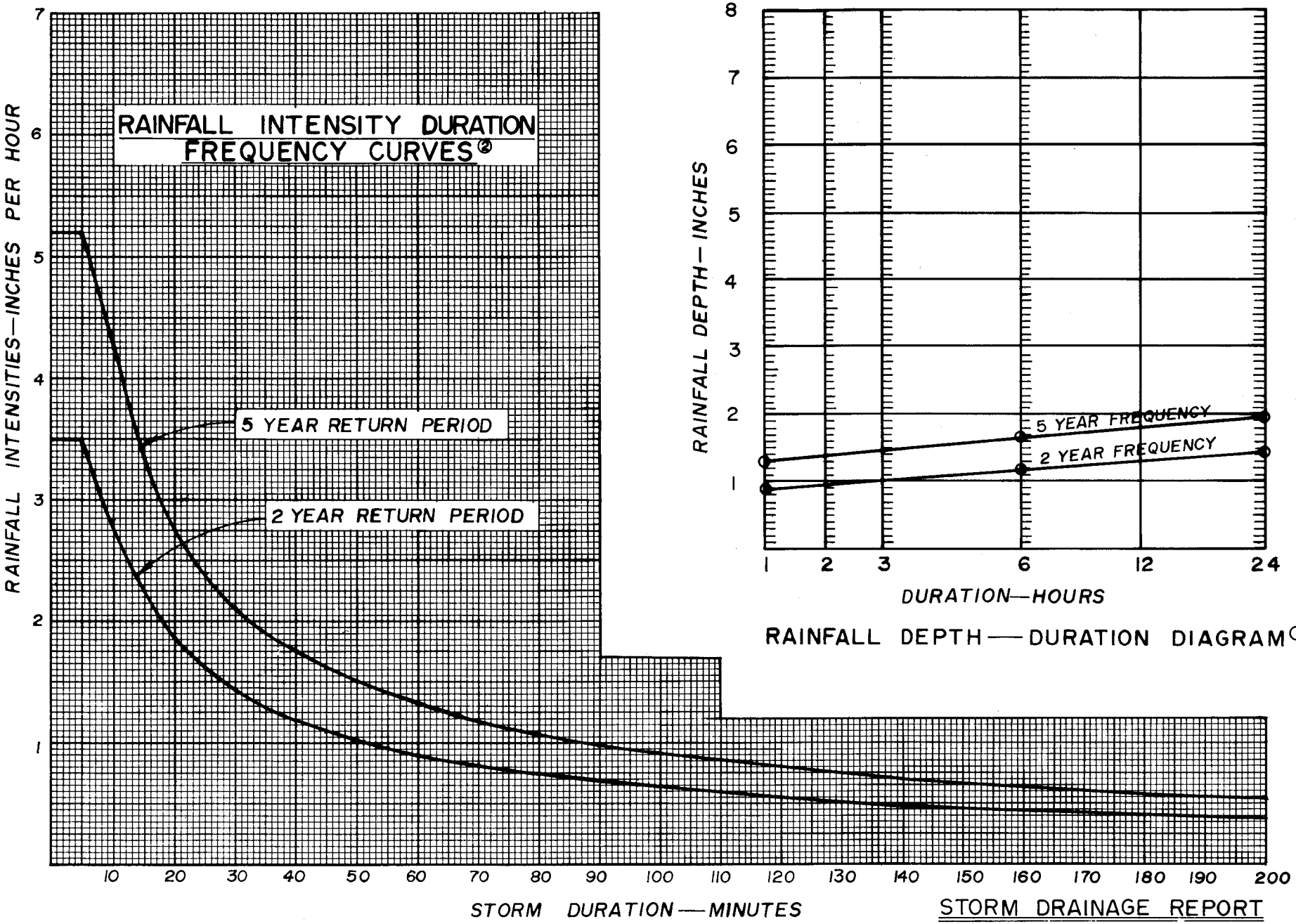
FREDONIA
Colorado City
Marble Canyon
Page
Kayenta
Mexican Water
Lukachukai
Chinle
Tonalea
Tuba City
Moenkopi
Pinon
Grand Canyon
North Rim
Cameron
Oraibi
Keams Canyon
Second Mesa
Ganado
Gray Mountain
Valle
Seba Dalkai
Wide Ruins
Lupton
Sanders
Peach Springs
Chloride
Seligman
WILLIAMS
Ash Fork
FLAGSTAFF
Leupp
KINGMAN
WINSLOW
Joseph City
HOLBROOK
Yucca
Sedona
CLARKDALE
JEROME
COTTONWOOD
Topock
Wikieup
Bagdad
Lake Havasu City
PRESCOTT
Dewey
Camp Verde
Clint Well
Heber
SNOWFLAKE
TAYLOR
ST. JOHNS
Concho
Hillside
Cottonwood Jct.
Pine
Overgaard
Pinedale
Yarnell
Congress
Black Canyon City
WICKENBURG
Foyson
Young
Carrizo
Indian Pine
SHOW LOW
SPRINGERVILLE
EAGAR
Greer
Nutrioso
Alpine
PARKER
Bouse
Aguila
Morristown
New River
Cave Creek
Sacaton
White River
Splonie
Hope
Quartzsite
Ehrenberg
Tonopah
GLENDALE
PHOENIX
SCOTTSDALE
Apache Jct.
MIAMI
GLOBE
San Carlos
TEMPE
MESA
Superior
BUCKEYE
CHANDLER
Florence Jct.
Morenci
CLIFTON
KEARNY
FLORENCE
GILA BEND
CASA GRANDE
COOLIDGE
WINKELMAN
PIMA
SAFFORD
THATCHER
DUNCAN
YUMA
Mobawk
Sentinel
SOMERTON
Wellton
San Luis
ELOY
Picacho
MAMMOTH
Oracle
San Manuel
Bowie
San Simon
Ajo
Why
TUCSON
WILCOX
Dos Cabezas
Cochise
Quijotoa
Robles Ranch
BENSON
St. David
Pearce
Lukeville
Sells
TOMBSTONE
Sonoita
Tubac
SIERRA VISTA
Mescal
PATAGONIA
Sasabe
BISBEE
Naco
DOUGLAS

PLATE 14



RAINFALL DEPTH—DURATION DIAGRAM①

App A-12

STORM DRAINAGE REPORT

TEMPE, ARIZONA

W B TECHNICAL PAPER NO. 40

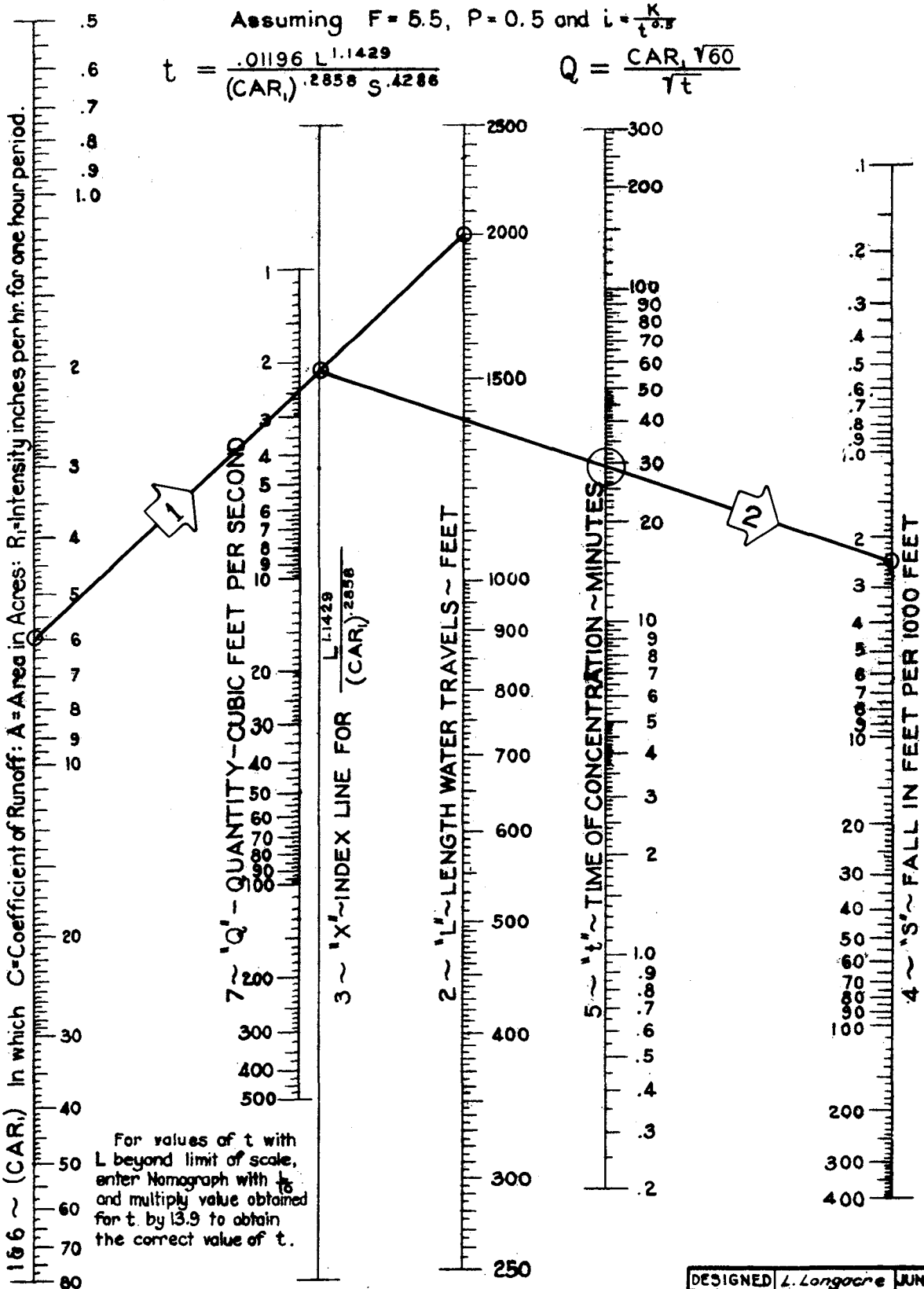
John Carollo Engineers PLATE 15

COUNTY OF LOS ANGELES CALIFORNIA
OFFICE OF COUNTY SURVEYOR

TIME OF CONCENTRATION & QUANTITY AT INLET POINT

Assuming $F = 5.5$, $P = 0.5$ and $i = \frac{K}{t^{0.5}}$

$$t = \frac{.01196\, L^{1.1429}}{(CAR_1)^{.2858}\, S^{.4286}} \qquad Q = \frac{CAR_1 \sqrt{60}}{\sqrt{t}}$$



For values of t with L beyond limit of scale, enter Nomograph with $\frac{L}{10}$ and multiply value obtained for t by 13.9 to obtain the correct value of t.

Reference Trans. A.S.C.E. vol. 96 p. 1038

DESIGNED	L. Longacre	JUNE 1931
TRACED	L. B. Knox	MAY 1956

STORM DRAINAGE REPORT
TEMPE, ARIZONA

John Carollo Engineers

STANDARD Dd-30®

PLATE 16

Square Roots of Decimal Numbers

Number	.---0	.---1	.---2	.---3	.---4	.---5	.---6	.---7	.---8	.---9
.00001	.003162	.003317	.003464	.003606	.003742	.003873	.004000	.004123	.004243	.004359
.00002	.004472	.004583	.004690	.004796	.004899	.005000	.005099	.005196	.005292	.005385
.00003	.005477	.005568	.005657	.005745	.005831	.005916	.006000	.006083	.006164	.006245
.00004	.006325	.006403	.006481	.006557	.006633	.006708	.006782	.006856	.006928	.007000
.00005	.007071	.007141	.007211	.007280	.007348	.007416	.007483	.007550	.007616	.007681
.00006	.007746	.007810	.007874	.007937	.008000	.008062	.008124	.008185	.008246	.008307
.00007	.008367	.008426	.008485	.008544	.008602	.008660	.008718	.008775	.008832	.008888
.00008	.008944	.009000	.009055	.009110	.009165	.009220	.009274	.009327	.009381	.009434
.00009	.009487	.009539	.009592	.009644	.009695	.009747	.009798	.009849	.009899	.009950
.00010	.010000	.010050	.010100	.010149	.010198	.010247	.010296	.010344	.010392	.010440
.0001	.01000	.01049	.01095	.01140	.01183	.01225	.01265	.01304	.01342	.01378
.0002	.01414	.01449	.01483	.01517	.01549	.01581	.01612	.01643	.01673	.01703
.0003	.01732	.01761	.01789	.01817	.01844	.01871	.01897	.01924	.01949	.01975
.0004	.02000	.02025	.02049	.02074	.02098	.02121	.02145	.02168	.02191	.02214
.0005	.02236	.02258	.02280	.02302	.02324	.02345	.02366	.02387	.02408	.02429
.0006	.02449	.02470	.02490	.02510	.02530	.02550	.02569	.02588	.02608	.02627
.0007	.02646	.02665	.02683	.02702	.02720	.02739	.02757	.02775	.02793	.02811
.0008	.02828	.02846	.02864	.02881	.02898	.02915	.02933	.02950	.02966	.02983
.0009	.03000	.03017	.03033	.03050	.03066	.03082	.03098	.03114	.03130	.03146
.0010	.03162	.03178	.03194	.03209	.03225	.03240	.03256	.03271	.03286	.03302
.001	.03162	.03317	.03464	.03606	.03742	.03873	.04000	.04123	.04243	.04359
.002	.04472	.04583	.04690	.04796	.04899	.05000	.05099	.05196	.05292	.05385
.003	.05477	.05568	.05657	.05745	.05831	.05916	.06000	.06083	.06164	.06245
.004	.06325	.06403	.06481	.06557	.06633	.06708	.06782	.06856	.06928	.07000
.005	.07071	.07141	.07211	.07280	.07348	.07416	.07483	.07550	.07616	.07681
.006	.07746	.07810	.07874	.07937	.08000	.08062	.08124	.08185	.08246	.08307
.007	.08367	.08426	.08485	.08544	.08602	.08660	.08718	.08775	.08832	.08888
.008	.08944	.09000	.09055	.09110	.09165	.09220	.09274	.09327	.09381	.09434
.009	.09487	.09539	.09592	.09644	.09695	.09747	.09798	.09849	.09899	.09950
.010	.10000	.10050	.10100	.10149	.10198	.10247	.10296	.10344	.10392	.10440
.01	.1000	.1049	.1095	.1140	.1183	.1225	.1265	.1304	.1342	.1378
.02	.1414	.1449	.1483	.1517	.1549	.1581	.1612	.1643	.1673	.1703
.03	.1732	.1761	.1789	.1817	.1844	.1871	.1897	.1924	.1949	.1975
.04	.2000	.2025	.2049	.2074	.2098	.2121	.2145	.2168	.2191	.2214
.05	.2236	.2258	.2280	.2302	.2324	.2345	.2366	.2387	.2408	.2429
.06	.2449	.2470	.2490	.2510	.2530	.2550	.2569	.2588	.2608	.2627
.07	.2646	.2665	.2683	.2702	.2720	.2739	.2757	.2775	.2793	.2811
.08	.2828	.2846	.2864	.2881	.2898	.2915	.2933	.2950	.2966	.2983
.09	.3000	.3017	.3033	.3050	.3066	.3082	.3098	.3114	.3130	.3146
.10	.3162	.3178	.3194	.3209	.3225	.3240	.3256	.3271	.3286	.3302

STANDARD Dd-32 ⑥

JOHN CAROLLO ENGINEERS
Phoenix, Arizona

HYDRAULIC PROPERTIES OF CIRCULAR CONDUITS
FULL FLOW
MANNING'S FORMULA

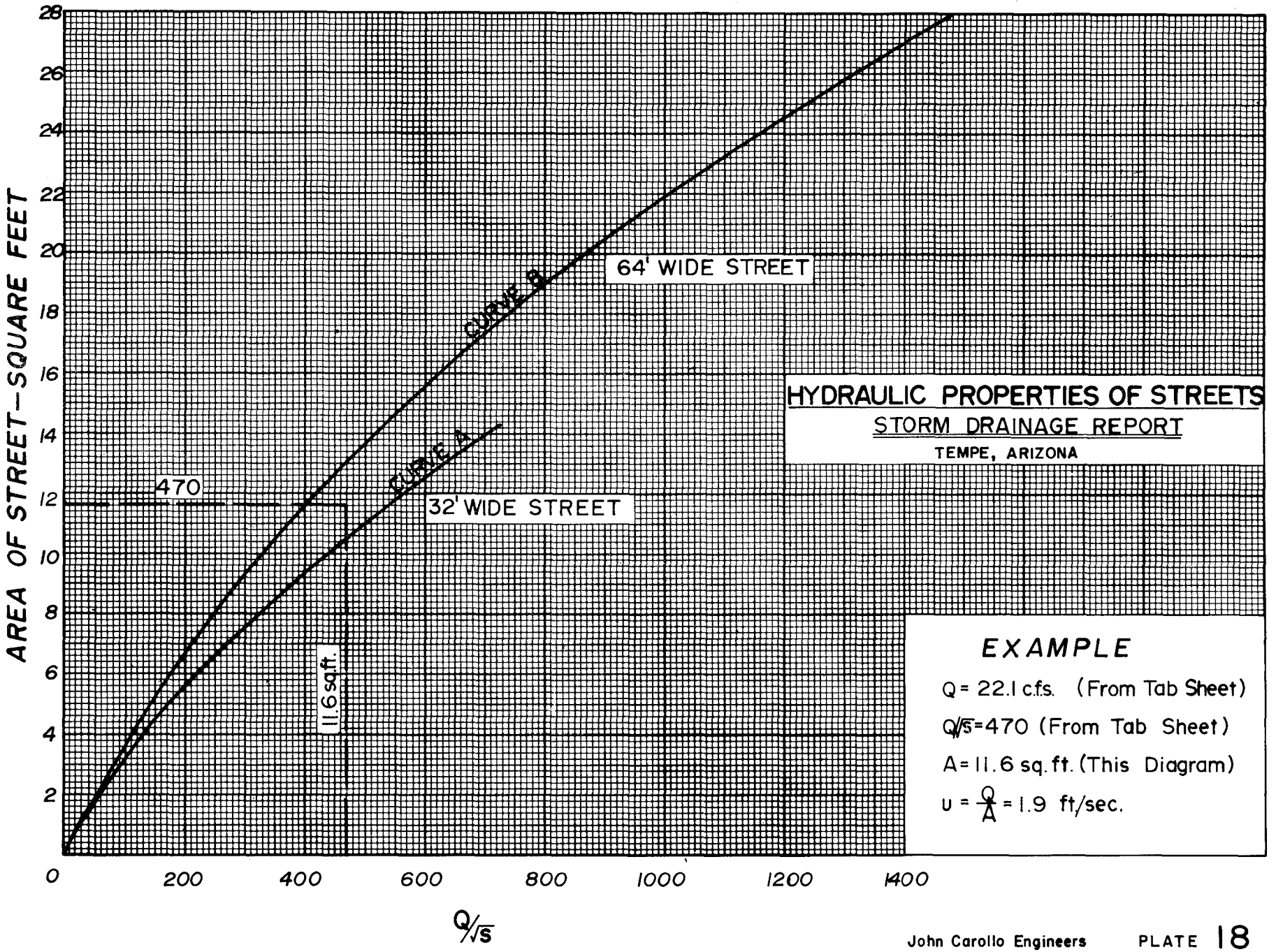
$v = K r^{2/3} s^{1/2}$ $\quad n = 0.01 \quad$ $h_f = L \cdot S$

$K = \frac{1.486}{0.010}$ $\quad t = \frac{L}{v \cdot 60}$

$\frac{Q}{\sqrt{s}} = a K r^{2/3}$ $\quad v = \frac{Q}{A} \quad$ $\sqrt{s} = Q/Q/\sqrt{s}$

Diameter in Inches	Area Sq. Ft.	Kr 2/3	$Q/\sqrt{s}$	
12	0.785	58.99	46	
14	1.069	65.38	70	
15	1.227	68.65	84	
16	1.396	71.33	100	
18	1.767	77.42	137	
20	2.182	83.07	181	
21	2.405	85.74	206	
22	2.640	88.42	233	
24	3.142	93.62	294	
26	3.687	98.82	364	
27	3.976	101.35	403	
30	4.909	108.63	533	
33	5.940	115.76	688	
36	7.096	122.74	871	
39	8.296	128.98	1,070	
42	9.621	135.97	1,308	
45	11.045	142.36	1,572	
48	12.566	148.60	1,867	
51	14.186	154.84	2,197	
54	15.904	160.79	2,557	
57	17.721	166.73	2,955	
60	19.635	172.38	3,385	
63	21.648	178.02	3,854	
66	23.758	183.67	4,364	
69	25.967	189.32	4,916	
72	28.274	194.67	5,504	
75	30.680	200.02	6,137	
78	33.183	205.37	6,815	
81	35.785	210.71	7,540	
84	38.485	215.92	8,310	
87	41.282	220.47	9,122	
90	44.179	228.87	9,979	
93	47.149	231.07	10,895	
96	50.265	235.83	11,854	
102	56.745	245.64	13,939	
108	63.617	255.15	16,232	
114	70.882	264.66	18,760	
120	78.540	273.72	21,498	
126	86.590	282.64	24,474	

PLATE 17



John Carollo Engineers PLATE 18

DESIGN

The complete hydraulic design was accomplished on Drainage Tabulation Sheets, pages A-17 through A-30. These sheets develop the quantity of runoff expected at specific points at specific times, also indicated are pipe sizes required for estimated flows at the pipe grades shown.

The time of concentration at the top of the drainage tabulation sheet was derived from Plate 16; the slope and length of the reach were taken from topographic maps, Reference 7. The areas indicated are found on Plates 8, 9, and 10 which are similar to the actual design maps, but at a reduced scale for the purpose of illustration.

The channel was designed to accommodate both Tempe and Arizona Highway Department flood flows. Maximum depth for the lined channel ranges from 6.3 feet to 7.5 feet with increased depth at bridges.

TABLED BY: R.G.W. DATE 4-11-72
CHECKED BY: DATE

JOHN CAROLLO ENGINEERS

DRAINAGE TABULATION SHEET

PROJECT: TEMPE STORM DRAIN SHEET 1 OF 1
JOB Nº 1854
LINE: SOUTHERN AVE.

Line No.	Drainage Area	Acres A	Total Acres	C	CA	ΣCA	Rainfall Intensity i	Q c.f.s.	Gradient S	$\sqrt{S}$	$\frac{Q}{\sqrt{S}}$	Size	Feet Per Sec. V	Minutes t	Feet L	Station	Elev. Hyd. Grade	Street and Limits
1			CAR =	3.33		S = 1.0		L = 1550'				T_c = 32.0 MIN.						
2																		
3	A_1	10.7		.35	3.7	3.7	1.36	5.0	.0010	.0316	159	CURVE "A"	1.0	32.0 5.0	300			NEWBERRY - TERRACE ON MANHATTON
4	A_2	3.1		.35	1.1	4.8	1.24	6.0	.0010	.0316	188	CURVE "A"	1.1	37.0 12.4	820			MANHATTON - LAGUNA ON TERRACE
5	A_3	27.2		.35	9.5	14.3	1.03	14.7	.0010	.0316	467	CURVE "A"	1.4	49.4 4.9	410			LAGUNA - MALIBU ON TERRACE
6	A_4	9.1		.35	3.1	17.4	.96	16.7	.0016	.0400	418	CURVE "A"	1.7	54.3 1.6	160			TERRACE - WEST TO ALLEY ON MALIBU
7	A_5	4.4		.35	1.5	18.9	.94	17.8	.0020	.0447	398	30" RCP	3.6	56.9 2.9	620			ALLEY NORTH - SOUTHERN ON ALLEY WEST OF TERRACE
8	A_6 & A_7	24.8		.35	8.7	27.6	.90	24.8	.0025	.0500	497	30" RCP	5.1	59.8 2.9	900			ALLEY WEST - RURAL ON SOUTHERN
9	A_8 - A_{13}	56.8		.45	25.5	53.1	.88	46.7	.0025	.0500	933	39" RCP	5.6	61.7 3.1	1050			RURAL - WEST OF LIBRARY ON SOUTHERN
10	A_{14}	21.0		.60	12.6	65.7	.85	55.8	.0016	.0400	1395	42" RCP	5.8	64.8 .8	270			WEST OF LIBRARY - McALLISTER ON SOUTHERN
11	A_{15}	14.5		.35	5.1	70.8	.85	60.2	.0016	.0400	1502	45" RCP	5.4	65.6 .9	290			McALLISTER - VENTURA ON SOUTHERN
12	A_{16}	4.9		.35	1.7	72.5	.84	60.9	.0017	.0412	1480	45" RCP	5.5	66.5 1.3	425			VENTURA - LACORTA ON SOUTHERN
13	A_{17}	4.5		.35	1.6	74.1	.83	61.5	.0013	.0361	1703	48" RCP	4.8	67.8 2.2	620			LACORTA - COLLEGE ON SOUTHERN
14	A_{18}	3.1		.54	1.7	75.8	.81	61.4						70.0				
15																		
16																		
17																		
18																		
19																		
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23																		
24																		
25																		
26																		
27																		
28																		
29																		
30																		

TABLED BY: R.G.W. DATE 4-11-72
CHECKED BY: DATE

JOHN CAROLLO ENGINEERS

DRAINAGE TABULATION SHEET

PROJECT: TEMPE STORM DRAIN SHEET 1 OF 1
JOB Nº 1854
LINE: ALAMEDA

Line No.	Drainage Area	Acres A	Total Acres	C	CA	ΣCA	Rainfall Intensity i	Q c.f.s.	Gradient S	$\sqrt{S}$	$\frac{Q}{\sqrt{S}}$	Size	Feet Per Sec. V	Minutes t	Feet L	Station	Elev. Hyd. Grade	Street and Limits
1			CAR =	5.92		L = 2000'			S =	2.4		T_c = 29.4	MINUTES					
2																		
3	B_1	16.6		.40	6.6	6.6	1.45	9.6	.0016	.0400	239	CURVE "A"	1.5	29.4 6.7	600			GENEVA - LOYOLA ON TERRACE
4	B_2 & B_3	29.3		.35	10.3	16.9	1.26	21.3	.0016	.0400	532	CURVE "A"	1.9	36.1 12.1	1380			TERRACE - RURAL ON LOYOLA
5	$B_4 - B_6$	37.0		.27	10.0	26.9	1.06	28.5	.0013	.0361	790	33" RCP	4.8	48.2 2.2	640			LOYOLA - CAMPUS ON RURAL
6	B_7	22.4		.35	7.8	34.7	1.02	35.4	.0035	.0592	598	33" RCP	6.0	50.4 1.5	550			CAMPUS - ALAMEDA ON RURAL
7	$B_8 - B_{11}$	57.7		.36	21.0	55.7	1.00	55.7	.0035	.0592	940	36" RCP	7.8	51.9 1.3	600			RURAL - CAMPUS ON ALAMEDA
8	B_{12}	9.4		.43	4.0	59.7	.98	58.4	.0015	.0387	1510	45" RCP	5.3	53.2 4.1	1300			CAMPUS - LOYOLA ON ALAMEDA
9	B_{13}	33.2		.35	11.6	71.3	.93	66.3	.0016	.0400	1660	45" RCP	6.0	57.3 2.1	750			LOYOLA - COLLEGE ON ALAMEDA
10	$B_{14} - B_{20}$	134.9		.40	54.0	125.3	.91	114.0	.0016	.0400	2850	57" RCP	6.4	59.4 3.8	1470			COLLEGE - MILL ON ALAMEDA
11	$B_{21} - B_{23}$	86.0		.42	36.1	161.4	.87	140.0	.0014	.0374	3750	63" RCP	6.5	63.2 3.0	1150			MILL - R.R. ON ALAMEDA
12	$B_{24} - B_{26}$	59.4		.44	26.2	187.6	.85	159.6						66.2				
13																		
14																		
15																		
16																		
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30																		

TABLED BY: R. G. W. DATE 4-11-72
CHECKED BY: DATE

JOHN CAROLLO ENGINEERS

DRAINAGE TABULATION SHEET

PROJECT: TEMPE STORM DRAIN SHEET 1 OF 1
JOB Nº 1851
LINE: BROADWAY

Line No.	Drainage Area	Acres A	Total Acres	C	CA	ΣCA	Rainfall Intensity i	Q c.f.s.	Gradient S	$\sqrt{S}$	$\frac{Q}{\sqrt{S}}$	Size	Feet Per Sec. V	Minutes t	Feet L	Station	Elev. Hyd. Grade	Street and Limits
1	CAR = 8.97				L = 2160'				S = 1.3			T_c = 36.5 MIN.						
2																		
3	C_1	24.3		.41	10.0	10.0	1.27	12.7	.0016	.0400	317	CURVE "A"	1.6	36.5 2.7	260			LOMA VISTA – CONCORDIA ON RURAL
4	C_2	8.9		.35	3.1	13.1	1.23	16.1	.0016	.0400	402	CURVE "A"	2.8	39.2 2.3	385			CONCORDIA – BROADMOR ON RURAL
5	C_3	11.3		.35	4.0	17.1	1.17	20.0	.0010	.0316	633	CURVE "A"	2.5	41.5 8.8	1320			BROADMOR – BROADWAY ON RURAL
6	$C_4 - C_8$	44.9		.48	21.6	38.7	1.02	39.5	.0015	.0387	1020	30" RCP	4.8	50.3 1.8	525			RURAL TO GRANADA ON BROADWAY
7	C_9	6.4		.70	4.5	43.2	1.00	43.2	.0014	.0374	1150	30" RCP	5.2	52.1 1.0	520			GRANADA – LA ROSA ON BROADWAY
8	C_{10}	9.0		.42	3.8	47.0	.98	46.0	.0016	.0400	1150	30" RCP	5.5	53.1 1.9	630			LA ROSA – SIERRA VISTA ON BROADWAY
9	C_{11}	6.5		.20	1.3	48.3	.97	46.8	.0034	.0583	803	36" RCP	6.6	55.0 2.5	980			SIERRA VISTA – EL CAMINO ON BROADWAY
10	C_{12}	14.8		.20	3.0	51.3	.93	47.7	.0022	.0469	1020	30" RCP	5.7	57.5 1.0	330			EL CAMINO – COLLEGE ON BROADWAY
11	$C_{13} - C_{18}$	87.6		.18	15.8	67.1	.92	61.7	.0022	.0469	1310	42" RCP	6.4	58.5 1.9	720			COLLEGE – HAMMOND ON BROADWAY
12	C_{19}	6.3		.67	4.2	71.1	.90	64.2	.0023	.0529	1210	42" RCP	6.7	60.4 2.0	790			HAMMOND – MILL ON BROADWAY
13*	$C_{20} - C_{25}$				33.4	104.7	.87	91.2	.0030	.0447	2040	48" RCP	7.3	62.4 2.6	1140			MILL – RR ON BROADWAY
14	C_{26}	18.5		.22	4.1	108.8	.85	92.5						65.0				
15																		
16																		
17																		
18									EXISTING 48" RCP IN BROADWAY WILL ONLY ALLOW 90 C.F.S.									
19																		
20																		
21																		
22																		
23																		
24																		
25																		
26																		
27																		
28																		
29																		
30	* TOTAL Q FROM MILL AV. UNDERPASS CALC.																	

TABLED BY: R.G.W. DATE 4-20-72
CHECKED BY: DATE

JOHN CAROLLO ENGINEERS

DRAINAGE TABULATION SHEET

PROJECT: TEMPE STORM DRAIN SHEET 1 OF 2
JOB Nº 1854
LINE: Priest Line

Line No.	Drainage Area	Acres A	Total Acres	C	CA	ΣCA	Rainfall Intensity I	Q c.f.s.	Gradient S	$\sqrt{S}$	$\frac{Q}{\sqrt{S}}$	Size	Feet Per Sec. V	Minutes t	Feet L	Station	Elev. Hyd. Grade	Street and Limits
1			CAR =	14.35		L = 5130'		S = 2.2				T_c = 40.3 MIN.						
2																		
3	H_1	51.5		.31	15.9	15.9	1.18	18.8	.002	.0447	420	CURVE "A"	1.9	40.3 12.8	1460			1300' - 2600' N. GUADALUPE ON WESTERN CANAL
4	H_2	41.5		.63	26.1	42.0	.98	41.1	.002	.0447	920	36" RCP	5.8	53.1 2.9	1020			WESTERN CANAL - R.R. 2600' NORTH GUADALUPE
5	H_3, H_4, H_5	204.5		.38	77.6	119.8	.94	112.5	.0044	.0663	1700	48" RCP	9.0	56.0 2.4	1330			2600' NORTH GUADALUPE ALONG R.R. TO 1300' S. BASELINE
6	H_6, H_7, H_8	103.4		.41	42.5	162.3	.92	149.2	.0044	.0663	2250	51" RCP	10.5	58.4 2.2	1380			1300' SO. TO BASELINE ON R.R.
7	$H_9 - H_{13}$	126.4		.39	49.3	211.6	.89	187	.0014	.0374	5030	69" RCP	7.3	60.6 8.3	3650			BASELINE - MIDSECTION LINE SEC. 1 ALONG CANAL
8	$H_{14} - H_{20}$				76.1	287.7	.82	236.	.0011	.0374	6300	75" RCP	7.7	68.9 4.5	2060			MIDSECTION LINE - PRIEST ALONG CANAL
9	$H_{21} - H_{24}$				70.2	357.9	.78	279.	.007	.0837	3340	60" RCP	14.2	73.4 1.6	500			CANAL - 500 NORTH ON PRIEST
10	H_{25}, H_{26}	31.0		.35	10.9	368.8	.77	284.	.006	.0775	3660	63" RCP	13.1	74.0 2.5	1050			500 NORTH - SOUTHERN ON PRIEST
11	$H_{27} - H_{36}$				115.2	484	.75	363	.003	.0548	6620	78" RCP	10.9	76.5 2.1	1370			SOUTHERN TO FAIRMONT ON PRIEST
12	H_{37}, H_{38}	40.0		.49	19.5	504	.74	373	.0021	.0458	8140	81" RCP	10.4	78.6 2.1	1300			FAIRMONT TO ALAMEDA ON PRIEST
13	$H_{39} - H_{47}$				166.2	670	.74	496	.003	.0548	9030	84" RCP	12.9	80.7 1.6	1250			ALAMEDA - 23 rd ST. ON PRIEST
14	H_{48}	50.5		.63	31.8	702	.73	512	.003	.0548	9350	87" RCP	12.4	82.3 1.8	1350			23 rd. ST. - BROADWAY ON PRIEST
15	$H_{54} - H_{55}$	75.2		.45	34.1	736	.72	528						84.1				
16																		
17																		
18																		
19																		
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TABLED BY: R.G.W. DATE 4-18-72
CHECKED BY: DATE

JOHN CAROLLO ENGINEERS

DRAINAGE TABULATION SHEET

PROJECT: TEMPE STORM DRAIN SHEET 2 OF 2
JOB Nº 1254
LINE: PRIEST LINE

Line No.	Drainage Area	Acres A	Total Acres	C	CA	ΣCA	Rainfall Intensity i	Q c.f.s.	Gradient S	$\sqrt{S}$	$\frac{Q}{\sqrt{S}}$	Size	Feet Per Sec. V	Minutes t	Feet L	Station	Elev. Hyd. Grade	Street and Limits
1	CAR = 16.55			L=3200'		S=3.3		Tc= 33.4 MIN.										
2	H_{17}	52.6		.35	18.4	18.4	1.33	24.5	.0071	.0843	290	24" RCP	7.8	33.4 5.2	2660			CENTER SECTION 4 T.1.S. R.4 E TO BASELINE
3	H_{18}	80.3		.35	28.1	46.5	1.23	57.2	.0060	.0775	739	33" RCP	9.6	38.6 2.3	1300			BASELINE - 600 SOUTH OF CANAL ON MIDSECTION LINE SEC 4
4	H_{19}, H_{20}	60.3		.35	21.1	67.6	1.18	79.7	.0050	.0894	892	36" RCP	11.2	40.9 1.4 42.3	920			600 SOUTH TO CANAL ON MIDLINE
5																		
6	CAR = 15.4			L=2600'		S=7.7		Tc= 18.8' MIN.										
7	H_{21}	43.3		.35	17.1	17.1	1.91	32.6	.003	.0548	596	30" RCP	6.7	18.8 1.6	670			MARGO - PRIEST ON BROADWAY
8	H_{22}	18.6		.35	6.5	23.6	1.82	43.0	.008	.0894	480	30" RCP	8.8	20.4 2.5	1330			BROADWAY - 1300 N. ON PRIEST
9	H_{23}	55.7		.35	19.5	43.1	1.72	74.1	.008	.0894	829	33" RCP	12.5	22.9 2.1 25.0	1540			1300' N. TO FREEWAY ON PRIEST
10	H_{24}	77.3		.35	27.1	70.2	1.62	113.5										
11																		
12	CAR = 10.25			L=2400'		S=1.2		Tc= 41 MIN.										
13	H_{27}	32.5		.35	11.4	11.4	1.18	13.5	.001	.0316	426	CURVE "A"	1.4	41.0 15.7	1320			SE 1/4 NE 1/4 SEC 33 T.1 N. R4E NORTH SOUTHERN
14	H_{28} - H_{30}	33.2		.57	21.9	33.3	.93	31	.0017	.0412	752	CURVE "A"	1.7	56.7 13.0	1320			ROOSEVELT TO HARDY ON SOUTHERN
15	H_{31} - H_{32}	71.6		.35	25	58.3	.82	47.8	.0025	.0500	956	39" RCP	5.8	69.7 3.9	1350			HARDY - SHAFER DR. ON SOUTHERN
16	H_{33}	60.0		.35	21	79.3	.79	62.7	.0015	.0387	1620	48" RCP	5.0	73.6 4.3 77.9	1280			SHAFER - PRIEST ON SOUTHERN
17	H_{34} - H_{36}	98.6		.36	35.9	115.2	.75	86.3										
18																		
19	CAR = 2.82			L=1650'		S=2.4		Tc= 29.0 MIN.										
20	H_{39}	10.1		.31	3.1	3.1	1.47	4.6	.0032	.0566	81	CURVE "A"	1.6	29.0 9.9	950			300' N. SOUTHERN TO 1300' NORTH ON ROOSEVELT
21	H_{40}	28.5		.63	17.9	21.0	1.23	25.8	.0014	.0374	690	CURVE "A"	1.9	38.9 11.3	1350			1300' WEST - HARDY ON FAIRMONT
22	H_{41}, H_{42}	40.1		.55	22.0	43.0	1.02	43.8	.0020	.0447	980	36" RCP	6.7	50.7 3.3	1320			FAIRMONT TO ALAMEDA ON HARDY
23	H_{43}, H_{44}	80.7		.63	50.8	93.8	.98	92.0	.0013	.0361	2540	54" RCP	5.8	54.0 3.9	1350			HARDY TO BECK ON ALAMEDA
24	H_{45}, H_{46}	80.0		.59	47.2	141.0	.93	131.0	.0013	.0361	3630	60" RCP	6.7	57.9 3.3 61.2	1310			BECK TO PRIEST ON ALAMEDA
25	H_{47}	40.0		.63	25.2	166.2	.89	148										
26																		
27																		
28																		
29																		
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TABLED BY: R.G.W. DATE 5-2-72
CHECKED BY: DATE

JOHN CAROLLO ENGINEERS

DRAINAGE TABULATION SHEET

PROJECT: TEMPE STORM DRAIN SHEET 1 OF 3
JOB Nº 1851
LINE: UNIVERSITY

Line No.	Drainage Area	Acres A	Total Acres	C	CA	ΣCA	Rainfall Intensity I	Q c.f.s.	Gradient S	$\sqrt{S}$	$\frac{Q}{\sqrt{S}}$	Size	Feet Per Sec. V	Minutes t	Feet L	Station	Elev. Hyd. Grade	Street and Limits
1					CONTINUED FROM LINE 5 ON SHEET 2 OF 3													
2																		
3	$F_{50}-F_{52}$ $F_{8}-F_{9}$, F_{10}	—		—	49.8	49.8	.83	41.3	.0014	.0374	1110	39" RCP	5.0	68.0 4.4	1320			HARDY - BECK ON UNIVERSITY
4	$F_{11}-F_{13}$ F_{17} F_{17a} F_{54}	—		—	22.1	72.2	.78	56.3	.0015	.0387	1460	42" RCP	5.9	72.4 3.7	1325			BECK - PRIEST ON UNIV.
5	F_{14} F_{16} F_{18} F_{16a} F_{16b} $F_{55}-F_{57}$	—		—	36.6	108.8	.77	83.8	.0040	.0633	1320	42" RCP	8.7	76.1 1.5	800			PRIEST - 800' WEST ON UNIV.
6	F_{22}	5.5		.27	2.0	110.8	.76	84.2	.0056	.0748	1125	42" RCP	8.7	77.6 1.1	550			800' WEST - LINDON ON UNIV.
7	F_{19} F_{23}	52.2		.40	20.3	131.1	.75	98.3	.0031	.0557	1770	45" RCP	8.9	78.7 1.3	670			LINDON - 700' WEST ON UNIV.
8	F_{20}	20.0		.35	7.0	138.1	.75	103.5	.0031	.0557	1860	48" RCP	8.2	80.0 1.3	650			700' WEST - 52ND ST. ON UNIV.
9	F_{24} F_{24}	26.5		.44	11.6	149.7	.74	110.8	.0025	.0500	2220	51" RCP	7.8	81.3 2.7	1270			UNIVERSITY - 660' SOUTH ON 52ND ST.
10	F_{26} F_{26a} F_{26b}	35.1		.53	18.8	168.5	.73	123.0	.0025	.0500	2460	54" RCP	7.7	84.0 1.4	660			660' SOUTH - WASTE DITCH
11	F_{25} - F_{27}	59.6		.34	20.3	188.8	.72	136.0						85.4				
12																		
13																		
14																		
15																		
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TABLED BY: RGW DATE 5-1-72
CHECKED BY: DATE

JOHN CAROLLO ENGINEERS

DRAINAGE TABULATION SHEET

PROJECT: TEMPE STORM DRAIN SHEET 2 OF 3
JOB Nº 1854
LINE: UNIVERSITY (5th St.)

Line No.	Drainage Area	Acres A	Total Acres	C	CA	ΣCA	Rainfall Intensity i	Q c.f.s.	Gradient S	$\sqrt{S}$	$\frac{Q}{\sqrt{S}}$	Size	Feet Per Sec. V	Minutes t	Feet L	Station	Elev. Hyd. Grade	Street and Limits
1		CAR = 3.75			L =	2000'		S =	1.2			T_c =	45.0	MIN.				
2																		
3	F50 F51	32.8		.20	6.8	6.8	1.10	7.4	.0021	.0458	163	CURVE "A"	1.5	45.0 17.1	1525			ROOSEVELT - HARDY ON 5TH ST.
4	F52	34.3		.20	6.9	13.7	.88	12.1	.0021	.0458	263	24" RCP	3.8	6.1 5.9	1350			HARDY - BECK ON 5TH ST.
5	F53	45.9		.30	13.8	27.5	.83	22.8						66.0				
6																		
7		CAR = 6.64			L =	2390'		S =	1.7			T_c =	40.5 MINUTES					
8																		
9	F55	32.1		.23	7.4	7.4	1.18	8.7	.0015	.0387	225	CURVE "A"	1.4	40.5 15.5	1300			BECK - PRIEST ON 5TH ST.
10	F56	25.0		.20	5.0	12.4	.95	11.8	.001	.0316	374	30" RCP	3.2	56.0 6.8	1350			5TH ST - UNIVERSITY ON PRIEST
11	F57	59.2		.22	8.7	21.1	.88	18.6						62.8				
12																		
13																		
14																		
15																		
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TABLED BY: R.G.W. DATE 4-17-72
CHECKED BY: DATE

JOHN CAROLLO ENGINEERS

DRAINAGE TABULATION SHEET

PROJECT: TEMPE STORM DRAIN SHEET 3 OF 3
JOB Nº 1854
LINE: UNIVERSITY

Line No.	Drainage Area	Acres A	Total Acres	C	CA	ΣCA	Rainfall Intensity i	Q c.f.s.	Gradient S	$\sqrt{S}$	$\frac{Q}{\sqrt{S}}$	Size	Feet Per Sec. V	Minutes t	Feet L	Station	Elev. Hyd. Grade	Street and Limits
1		CAR = 2.64			L = 1,250'			S = 3.0				T_c = 24.0 MINUTES						
2	F_1	8.4		.35	2.9	2.9	1.67	4.8	.002	.0447	108.	CURVE "A"	1.4	24.0 5.5	465			9TH - UNIVERSITY ON ROOSEVELT
3	F_2	8.4		.35	2.9	5.8	1.47	8.5	.0032	.0566	150	CURVE "A"	1.7	29.5 2.2	220			ROOSEVELT - MITCHELL ON UNIVERSITY
4	F_3 F_4	8.6		.35	3.0	8.8	1.39	12.2	.0032	.0566	216	CURVE "A"	1.9	31.7 5.3	610			MITCHELL - McKENNY ON UNIV.
5	F_5	16.7		.22	3.7	12.5	1.27	15.9	.0032	.0566	281	CURVE "A"	2.2	37.0 4.9	650			McKENNY - HARDY ON UNIV.
6	F_{10}	4.4		.70	3.1	15.6	1.16	18.1	.0027	.0520	348			41.9				
7																		
8		CAR = 0.66			L = 550'			S = 2.3				T_c = 13.0 MINUTES						
9	F_{5a}	2.1		.35	0.7	0.7	2.37	1.7	.0055	.0742	22	CURVE "A"	1.4	13.0 8.0	670			McKENNY - HARDY ON 10TH ST.
10	F_6	4.3		.35	1.5	2.2	1.80	4.0	.001	.0316	126	24" RCP	1.3	21.0 3.9	300			10TH - ELNA RAE ON HARDY
11	F_7	4.4		.35	1.5	3.7	1.61	6.0	.001	.0316	189	24" RCP	1.9	24.9 2.4	270			ELNA RAE - LAIRD ON HARDY
12	F_8	4.4		.35	1.5	5.2	1.51	7.8	.001	.0316	250	24" RCP	2.5	27.3 1.9	380			LAIRD - 9TH ST ON HARDY
13	F_9	4.4		.35	1.5	6.7	1.45	9.7	.0014	.0374	260	24" RCP	3.1	29.2 2.2	400			9TH - UNIVERSITY ON HARDY
14	F_1-F_5, F_{10}	—		—	15.6	22.3								31.4				
15																		
16		CAR = 2.58			L = 1450'			S = 3.6				T_c = 22.0 MINUTES						
17	F_{11}	8.2		.35	2.9	2.9	1.75	5.0	.0010	.0316	160	18" RCP	2.8	22.0 1.6	260			10TH - ELNA RAE ON BECK
18	F_{15}	8.2		.35	2.9	5.8	1.67	9.7	.0010	.0316	306	24" RCP	3.1	23.6 1.4	265			ELNA RAE - LAIRD ON BECK
19	F_{17}	8.2		.35	2.9	8.7	1.62	14.1	.0010	.0316	447	30" RCP	2.9	25.0 1.5	265			LAIRD - 9TH ON BECK
20	F_{17a}	8.2		.35	2.9	11.6	1.56	18.1	.0010	.0316	573	30" RCP	3.7	26.5 .6	135			9TH - UNIVERSITY ON BECK
21	F_{12} F_{13}	4.5		.70	3.2	14.8	1.53	22.7						27.1				
22																		
23		CAR = 2.58			L = 1485'			S = 3.5				T_c = 23.0 MIN.						
24	F_{14}	8.2		.35	2.9	2.9	1.70	4.9	.001	.0316	156	18" RCP	2.8	23.0 1.6	265			10TH - ELNA RAE ON PRIEST
25	F_{16}	8.2		.35	2.9	5.8	1.63	9.5	.001	.0316	299	24" RCP	3.0	24.6 1.5	265			ELNA RAE - LAIRD ON PRIEST
26	F_{18}	14.9		.35	5.2	11.0	1.57	17.3	.001	.0316	548	30" RCP	3.5	26.1 2.0	420			LAIRD - UNIVERSITY ON PRIEST
27	F_{18a}, F_{18b}	7.3		.62	4.5	15.5	1.50	23.2	.001	.0316				28.1				
28																		
29																		
30																		

TABLED BY: R. C. W. DATE 4-25-72
CHECKED BY: _____ DATE _____

JOHN CAROLLO ENGINEERS

DRAINAGE TABULATION SHEET

PROJECT: TEMPE STORM DRAIN SHEET 1 OF 2
JOB Nº 1854
LINE: 48TH ST.

Line No.	Drainage Area	Acres A	Total Acres	C	CA	ΣCA	Rainfall Intensity i	Q c.f.s.	Gradient S	$\sqrt{S}$	$\frac{Q}{\sqrt{S}}$	Size	Feet Per Sec. V	Minutes t	Feet L	Station	Elev. Hyd. Grade	Street and Limits
1	GAR = 3.39			L=1780'				S=1.0				T_c= 43.0 MIN.						
2	G_1	11.4		.35	4.0	4.0	1.14	4.6	.012	.110	41.	CURVE "A"	2.7	43.0 10.2	1650			BASELINE NORTH 1600' 1/4 MILE EAST 48th ST.
3	G_2	60.7		.35	21.2	25.2	.98	20.8	.010	.100	208	24" RCP	6.6	53.2 2.6	1020			1600' NORTH - VINEYARD 1/4 MILE EAST 48TH ST.
4	G_3	41.7		.35	14.6	39.8	.95	36.9	.010	.100	369	24" RCP	11.7	55.8 .9	520			VINEYARD - CANAL 1/4 MILE EAST OF 48TH ST.
5	G_4	23.0		.35	8.1	47.9	.94	45.0	.012	.0346	1300	42" RCP	4.7	56.5 4.7	1320			1/4 MILE EAST 48TH ST. - 48TH ST. ALONG CANAL
6	G_5-G_8				30.2	87.1	.89	77.5	.013	.114	680	33" RCP	13.0	61.2 1.3	1020			CANAL - 1000' NORTH ON 48TH ST.
7	G_9	24.6		.54	13.3	100.4	.88	88.3	.0051	.0714	1240	39" RCP	10.7	62.5 2.1	1370			1000' N. - SOUTHERN ON 48TH ST.
8	G_{10}-G_{11}	109.0		.54	58.8	159.2	.85	135.0	.0024	.0490	2760	54" RCP	8.5	64.6 2.6	1340			SOUTHERN - 1/4 MILE NORTH ON 48TH ST.
9	G_{12}	40.7		.35	14.2	173.4	.83	144.0	.0024	.0490	2940	57" RCP	8.1	67.2 2.8	1340			1/4 MILE N. - 1/2 MILE NORTH ON 48TH ST.
10	G_{13}-G_{17}				71.4	244.8	.77	189.0	.0018	.0603	3130	57" RCP	10.6	70.9 2.0	1285		*	1/2 MILE N. - 3/4 MILE NORTH ON 48TH ST.
11	G_{18}	31.3		.10	3.1	247.9	.76	188	.0054	.0735	2560	54" RCP	11.8	72.9 1.8	1300			3/4 MILE NORTH - BROADWAY ON 48TH ST.
12	G_{19}	46.1		.26	11.8	259.7	.75	195	.0026	.0510	3820	63" RCP	9.0	74.7 .8	430			BROADWAY - 430' NORTH ON 48TH ST
13	G_{20}	11.8		.70	8.3	268.0	.74	198.	.0018	.0424	4680	66" RCP	8.3	80.5 1.0	530			400' NORTH - 1000' NORTH OF BROADWAY ON 48TH ST
14	G_{21}	11.9		.67	8.0	276.0	.73	201	.0018	.0424	4750	60" RCP	7.8	81.5 5.8	2770			1000' N. - WASTE DITCH ON 48TH ST.
15	G_{22}-G_{28}	61.3		.58	35.6	311.6	.71	221						87.4				
16																		
17																		
18																		
19																		
20																		
21																		
22																		
23																		
24																		
25																		
26																		
27																		
28																		
29																		
30	* NON TYPE INLET ON ST. NO. 2					LINE	14											

TABLED BY: R.G.N. DATE 4-25-72
CHECKED BY: _____ DATE _____

JOHN CAROLLO ENGINEERS

DRAINAGE TABULATION SHEET

PROJECT: TEMPE STORM DRAIN SHEET 2 OF 2
JOB Nº 1854
LINE: 48TH ST

Line No.	Drainage Area	Acres A	Total Acres	C	CA	ΣCA	Rainfall Intensity i	Q c.f.s.	Gradient S	$\sqrt{S}$	$\frac{Q}{\sqrt{S}}$	Size	Feet Per Sec. V	Minutes t	Feet L	Station	Elev. Hyd. Grade	Street and Limits
1	CAR = 5.20				L=	1720'			S=1.0			T_c=37.4 MIN.						
2																		
3	G_5	16.5		.35	5.8	5.8	1.25	7.3	.012	.110	66	CURVE"A"	4.8	37.1 / 5.0	1900			BASELINE - CARSON ON 48TH ST.
4	G_6	61.5		.35	21.5	27.3	1.12	30.6	.010	.100	[illegible]	24" RCP	9.7	44.3 / 1.2	700			CARSON - VINYARD ON 48TH ST
5	G_7	21.4		.35	7.5	34.8	1.10	38.3	.010	.100	[illegible]	27" RCP	9.6	45.5 / .4	240			VINYARD - CABRL ON 48TH ST.
6	G_8	12.5		.35	4.4	39.2	1.10	43.0						45.9				
7																		
8	CAR = 1.28				L=	805			S=1.0			T_c=27.0 MIN						
9																		
10	G_{13a}	6.8		.21	1.4	1.4	1.54	2.16	.0017	.0412	52	CURVE"A"	1.0	27.0 / 21.0	1255			HUNTINGTON - ALLEY NORTH ON HARL
11	G_{13b} G_{13c}	26.9		.40	10.8	12.2	1.06	12.9	.001	.0316	410	CURVE"A"	1.4	28.0 / 9.5	800			HARL - FREEWAY ON ALLEY NORTH
12	G_{13d}	20.7		.35	7.3	19.5	.93	18.1	.001	.0316	573	*33" RCP	3.1	37.5 / 4.6	800			EASTSIDE FREEWAY - 900' WEST OF FREEWAY
13	G_{13}	13.2		.31	4.1	23.6	.88	20.8	.0022	.0469	443	27" RCP	5.2	42.3 / 1.1	1280			NORTH - BASEBALL FACE ON LINE 900' WEST OF FREEWAY
14	G_{14}	18.6		.31	5.8	29.4	.84	24.7	.0012	.0346	714	33" RCP	4.2	43.4 / 4.8	1200			WEST TO ¼ MILE EAST OF 48TH ST ON BOUNDARY OF RAIL LINE
15	G_{15} G_{16}	78.7		.35	27.5	56.9	.80	45.5	.0014	.0374	1220	42" RCP	4.7	48.2 / 4.4	1320			¼ MILE EAST 48TH - 2675' ON SOUTH BOUNDARY OF RAILROAD
16	G_{17}	41.3		.35	14.5	71.4	.77	55.0						75.0				
17																		
18																		
19																		
20																		
21																		
22																		
23																		
24																		
25																		
26																		
27																		
28																		
29																		
30	* 2 - 34" RCP UNDER [illegible]																	

TABLED BY: R.G.W. DATE 7-19-72
CHECKED BY: _____ DATE _____

JOHN CAROLLO ENGINEERS

DRAINAGE TABULATION SHEET

PROJECT: TEMPE STORM DRAIN SHEET 1 OF 1
JOB Nº 1854
LINE: MILL AVE. LATERAL

Line No.	Drainage Area	Acres A	Total Acres	C	CA	ΣCA	Rainfall Intensity i	Q c.f.s.	Gradient S	$\sqrt{S}$	$\frac{Q}{\sqrt{S}}$	Size	Feet Per Sec. V	Minutes t	Feet L	Station	Elev. Hyd. Grade	Street and Limits
1			CAR =	8.53		L = 2120			S = 0.00094			t_c =	42.0	MINUTES				
2																		
3	$A_{50}, A_{51}, A_{55}, A_{58}$	43.4		.62	27.0	27.0	1.15	31.0 * 8.0						42.0				
* 4	A_{55_C}							39.0	.0011	.03317	1175	39" RCP	4.7	1.5	440			ELLIS DR - NORTH ON MILL
5	A_{52}, A_{53},	23.4		.36	8.1	35.1	1.13	39.7 * 9.0	.0011	.03317	1470	45" RCP	4.4	43.5 3.6	960			- CARTER ON MILL
6	A_{55_D}, A_{53}, A_{56}	55.9		.40	22.5	57.6	1.06	61.2 * 11.4	.0011	.03317	2180	51" RCP	5.2	47.1 2.3	700			CARTER - FREEWAY ON MILL
7	A_{52}, A_{54}, A_{59}	37.3		.35	13.2	70.8	1.03	72.8 * 11.8	.0010	.03162	2680	54" RCP	5.3	49.4	1380			MILL - COLLEGE ON SOUTH R/W F.W.
8																		
9																		
10																		
11																		
12																		
13																		
14																		
15																		
16																		
17																		
18																		
19																		
20																		
21																		
22																		
23																		
24																		
25																		
26																		
27																		
28																		
29																		
30	* FROM BASIN																	

TABLED BY: RG.W. DATE 7-13-72

CHECKED BY: _____ DATE _____

JOHN CAROLLO ENGINEERS

DRAINAGE TABULATION SHEET

PROJECT: TEMPE STORM DRAIN SHEET 1 OF 1

JOB Nº 1854

LINE: DARTMOUTH LATERAL

Line No.	Drainage Area	Acres A	Total Acres	C	CA	ΣCA	Rainfall Intensity i	Q c.f.s.	Gradient S	$\sqrt{S}$	$\frac{Q}{\sqrt{S}}$	Size	Feet Per Sec. V	Minutes t	Feet L	Station	Elev. Hyd. Grade	Street and Limits
1			CAR =	6.58		L =	1960		S =	0.0008		T_c =	46	MINUTES				
2																		
3	R_1	2.0		.37	7.4	7.4	1.08	8.0	.0010	.0316	253	22"RCP	3.0	46.0 3.7	660			LAROSA - 660' WESTON WINCHESTER
4	R_2	2.0		.35	7.0	14.4	1.03	14.9	.0010	.0316	470	27"RCP	3.7	49.7 .7	150			660' WEST - COLLEGE ON WINCHESTER
5	R_3	8.7		.35	3.0	17.4	1.02	17.8	.0035	.0592	300	24"RCP	5.7	50.4 1.3	430			WINCHESTER - JULIE ON COLLEGE
6	R_4 R_5	13.4		.35	4.7	22.1	.99	21.9	.0027	.0520	422	27"RCP	5.5	51.7 2.8	910			COLLEGE - SESAME ON FOREST
7	R_6 - R_{12}	40.3		.35	14.1	36.2	.96	34.7	.0044	.0663	524	30"RCP	7.1	54.5 .5	320			SESAME - DARTMOUTH ON FOREST
8	R_{13} - R_{15}	19.3		.35	6.7	42.9	.95	40.8	.0013	.0361	1130	39"RCP	4.9	55.0 4.6	1350			FOREST - OXFORD ON DARTMOUTH
9	R_{16} - R_{35}	170.0		.44	74.8	117.2	.90	105.5	.0016	.0400	2640	54"RCP	6.6	59.6 1.0	400			TO DETENTION BASIN
10	PARK	134.3		.05	6.7	123.9	.88	109						60.6				
11																		
12																		
13																		
14																		
15																		
16																		
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TABLED BY: RGW DATE 7-19-72
CHECKED BY: _____ DATE _____

JOHN CAROLLO ENGINEERS

DRAINAGE TABULATION SHEET

PROJECT: TEMPE STORM DRAIN SHEET 1 OF 2
JOB Nº 1864
LINE: COLLEGE AVE. MAIN PLAN "A"

Line No.	Drainage Area	Acres A	Total Acres	C	CA	ΣCA	Rainfall Intensity i	Q c.f.s.	Gradient S	$\sqrt{S}$	$\frac{Q}{\sqrt{S}}$	Size	Feet Per Sec. V	Minutes t	Feet L	Station	Elev. Hyd. Grade	Street and Limits
1			INITIAL		CA =	164	÷ .71	= 235			t_c =	78 MINUTES						
2																		
3	SOUTH OF FREEWAY	—		—	—	235	.75	176	.0006	.0245	7,180	78" RCP	5.5	78.0 1.0	330			FREEWAY - RIVIERA ON COLLEGE
4	A_{19}	3.3		.35	1.2	236	.74	174	.0006	.0245	7130	78" RCP	5.3	79.0 1.3	415			RIVIERA - HERMOSA ON COLLEGE
5	A_{20}	13.7		.35	4.8	241	.73	176	.0006	.0245	7,180	78" RCP	5.3	80.3 1.8	585			HERMOSA - LA JOLLA ON COLLEGE
6	A_{21} A_{22}	38.5		.35	13.5	255	.73	186	.0006	.0245	7,600	81" RCP	5.2	82.1 1.8	565			LA-JOLLA - LAGUNA ON COLLEGE
7	A_{23} A_{22a}	25.5		.35	8.9	264	.72	190	.0008	.0283	6,720	78" RCP	5.7	83.9 1.2	415			LAGUNA - MALIBU ON COLLEGE
8	A_{24}	11.1		.35	3.9	268	.71	190	.0008	.0283	6,720	78" RCP	5.7	85.1 .6	190			MALIBU - SOUTHERN ON COLLEGE
9	A_1 - A_{18}	—		—	75.8	344	.70	241	.0014	.0374	6,430	75" RCP	7.8	85.7 3.0	1420			COLLEGE - MILL ON SOUTHERN
10	A_{25} - A_{28}	77.1		.50	38.6	383	.68	260	.0011	.0332	7,840	81" RCP	7.3	88.7 2.8	1210			MILL - RR R/W ON SOUTHERN
11	A_{29} - A_{31}	28.8		.70	20.2 19.3*	422	.67	283	.0021	.0458	6,180	75" RCP	9.2	91.5 4.8	2660			SOUTHERN - ALAMEDA ON RR R/W
12	ALAMEDA LAT.	—		—	187.6	610	.64	390	.0016	.0400	9,770	87" RCP	9.5	96.3 4.7	2650			ALAMEDA - BROADWAY ON RR R/W
13	BROADWAY	—		—			.63	90	**					101.0				
14						TOTAL		480										
15																		
16	66" RCP @ 0.100 %					FARMER AVE.		MAIN	WILL	TAKE	140	C.F.S.		BROADWAY	WILL			TAKE 340 C.F.S.
17	FROM JUNCTION	—		—		540	.63	340	.0028	.0529	6,430	75" RCP	11.0	101.0 2.6	1330			RR - ROOSEVELT ON BROADWAY
18	H_{49}	79.1		.47	37.1	577	.62	357	.0019	.0436	8200	81" RCP	10.0	103.0 2.2	1310			ROOSEVELT - HARDY ON BROADWAY
19	H_{50} H_{51}	80.0		.56	44.8	622	.61	379	.0014	.0374	10150	93" RCP	8.0	105.2 2.0	960			HARDY - INDUSTRIAL PARK ON BROADWAY
20	H_{52} H_{53}	58.0		.58	33.6	656	.60	393	.0014	.0374	10,500	93" RCP	8.3	107.2 3.4	1700			INDUSTRIAL PARK - PRIEST ON BROADWAY
21	H_1 - H_{58}	—		—	736	1392	.58	807	.0025	.0500	16,150	108" RCP	12.7	110.6 2.5	1910			BROADWAY - JACOBS DITCH ON PRIEST
22	H_{59}	49.5		.35	17.3	1409	.57	803	.0025	.0500	16,000	108" RCP	12.6	113.1 1.8	1360		App A-29	WEST ALONG DITCH TO 52ND ST.
23	H_{60} H_{61}	60.5		.35	21.2	1430	.56	800	.0026	.0510	15,700	108" RCP	12.6	114.9 2.8	2080			NORTH TO TEMPE DRAINAGE ON 52ND ST.
24	F_{1-27} F_{50-57} H_{62}	—		—	215.4	1645	.55	905	.0025	.0500	18,100	10' CHANNEL	9.4	117.7 3.5	2000			52ND - 640' EAST OF 48TH ST. ON DRAIN EASE.
25	F_{28} F_{29}	106.0		.53	55.6	1701	.55	936	.0025	.0500	18,700	10' CHANNEL	9.7	121.2 1.1	650			650' EAST - 48TH ST. ON DRAINAGE EASE.
26	F_{30} - F_{32} G_1 - G_{23}	—		—	328.2	2029	.54	1095 150*	.00185	.0430	28,900	10' CHANNEL	10.5	122.3 8.0	5400			48TH - 40TH ST.
27			INCLUDES	A.H.D.	FLOW	2310	.50	1155	.0010	.0316	36,600	10' CHANNEL	8.0	130.9 5.7	2750			40TH - 36TH ST.
28	SEE TABLE #2 FOR CHANNEL					2310	.48	1110	.0016	.0400	27,800	10' CHANNEL	9.3	136.6 4.7	2650			36TH - RIVER
29	VALUES													141.3				
30			* FLOW	FROM		CANLEY	PARK =		CA =	19.3	&	A.H.D.	= 150	C.F.S.		**	DISCHARGE	FROM 48" RCP BROADWAY

TABLED BY: RGW. DATE 6-23-72
CHECKED BY: _____ DATE _____

JOHN CAROLLO ENGINEERS

DRAINAGE TABULATION SHEET

PROJECT: TEMPE STORM DRAIN SHEET 2 OF 2
JOB Nº 1854
LINE: COLLEGE AVE. MAIN PLAN "B"

Line No.	Drainage Area	Acres A	Total Acres	C	CA	ΣCA	Rainfall Intensity i	Q c.f.s.	Gradient S	$\sqrt{S}$	$\frac{Q}{\sqrt{S}}$	Size	Feet Per Sec. V	Minutes t	Feet L	Station	Elev. Hyd. Grade	Street and Limits
1			CA.R. - 6.42			S = 0.0010			L = 2200'			t_c = 4.0 MIN.						
2																		
3	A_{22}	20.6	—	.35	7.2	7.2	1.05	7.6	.0010	.03162	237	CURVE "A"	1.2	48.0 18.8	1350			McALLISTER - COLLEGE ON LA JOLLA
4	A_{19} A_{20} A_{21}	34.9	—	.35	12.2	19.4	.83	16.1	.0006	.02449	658	33" RCP	2.7	66.8 3.5	565			LA JOLLA - LAGUNA ON COLLEGE
5	A_{22a} A_{23}	25.5	—	.35	8.9	28.3	.80	22.6	.0008	.02828	800	36" RCP	3.2	70.3 2.2	415			LAGUNA - MALIBU ON COLLEGE
6	A_{24}	11.1	—	.35	3.9	32.2	.79	25.4	.0008	.02828	898	36" RCP	3.6	72.5 .9	190			MALIBU - SOUTHERN ON COLLEGE
7	$A_1 - A_{18}$	—	—	—	75.8	108.0	.78	84.2	.0014	.0374	2150	51" RCP	5.9	73.4 4.0	1420			COLLEGE - MILL ON SOUTHERN
8	$A_{25} - A_{28}$	77.1	—	.50	36.6	144.6	.75	108.2	.0011	.0332	3260	60" RCP	5.5	77.4 3.7	1210			MILL - RR R/W ON SOUTHERN
9	$A_{29} - A_{31}$	28.8	—	.70	20.2 19.3*	184.1	.74	136.3	.0021	.0458	2980	57" RCP	7.7	81.1 5.8	2660			SOUTHERN - ALAMEDA ON RR R/W
10	ALAMEDA	—	—	—	187.6	372.	.71	264	.0016	.0400	6600	78" RCP	8.0	86.9 5.5	2660			ALAMEDA - BROADWAY ON RR R/W
11	BROADWAY	—	—	—	108.8	481	.68	327						92.4				
12																		
13	66" RCP		@ 0.100 %		FARMER AVE MAIN WILL TAKE					140 c.f.s.		BROADWAY MAIN WILL TAKE 192 c.f.s.						
14	FROM JUNCTION	—	—	—	275	275	.68	187	.0028	.0529	3540	63" RCP	8.7	92.4 2.5	1530			RR - ROOSEVELT ON BROADWAY
15	H_{49}	79.0		.47	37.1	312	.67	209	.0019	.0436	4800	69" RCP	8.0	94.9 2.7	1310			ROOSEVELT - HARDY ON BROADWAY
16	H_{50} H_{51}	80.0		.56	44.8	351	.65	232	.0014	.0374	6220	75" RCP	7.5	97.6 2.1	960			HARDY - INDUSTRIAL PARK ON BROADWAY
17	H_{52} H_{53}	58.0		.58	33.6	391	.64	250	.0014	.0374	6700	78" RCP	7.5	99.7 3.8	1720			INDUSTRIAL PARK - PRIEST ON BROADWAY
18	$H_1 - H_{56}$	—		—	736	1127	.62	700	.0025	.0500	14,000	102" RCP	12.5	103.5 2.7	2020			BROADWAY - JACOBS DITCH ON PRIEST & WEST ON DITCH
19	H_{59}	49.5		.35	17.3	1144	.62	707	.0025	.0500	14,100	102" RCP	12.5	106.2 1.8	1360			WEST ALONG DITCH - 52ND ST.
20	$H_{60} - H_{61}$	60.5		.35	21.2	1165	.60	698	.0026	.0510	13,700	102" RCP	12.3	108.0 3.3	2460			NORTH - TEMPE DRAINAGE ON 52ND ST.
21	F_{1-27} F_{50-57} H_{62}	—		—	215.4	1380	.59	813	.0025	.0500	16,300	10' CHANNEL	12.8	111.3 2.6	2000			52ND - 600' EAST OF ABBY ST ON DRAINAGE DITCH
22	F_{28} F_{29}	106		.53	55.6	1436	.57	818	.0025	.0500	16,400	10' CHANNEL	13.0	113.9 .8	650			600' EAST - 48TH ST. ON DRAINAGE DITCH
23	F_{30-32} G_{1-23}	—		—	328	1764	.57	1007						114.7				
24																		
25																		
26																		
27																		
28																		
29																		
30																		

CONSTRUCTION COSTS

Construction costs were based upon current construction and material prices (July 1972). No attempt was made to escalate costs since a time table for construction has not been established.

Construction costs for concrete structures were established based on certain classes of structure as listed below:

Class I	Junction structure for 36"-60" pipe
Class II	Junction structure for 63"-78" pipe
Class III	Junction structure for 81"-108" pipe
Class IV	Transition structure for 36"-48" pipe
Class V	Transition structure for 51"-69" pipe
Class VI	Transition structure for 72"-108" pipe

Concrete catch basins are Tempe Standard 247, Type A, B, and C.

The 10-foot channels include excavation, lining, service road, and security fence on either side.

Following are tabulations on the quantities and construction costs for trunks, laterals, and branches.

COLLEGE AVENUE TRUNK - PHASE I

PLAN A

Item	Units	Quantity	Unit Cost	Total
			$	$
108" RCP	LF	5,350	200	1,070,000
93" RCP	LF	2,660	95	252,700
87" RCP	LF	2,650	85	225,250
81" RCP	LF	3,085	81	249,885
78" RCP	LF	1,935	78	150,930
75" RCP	LF	5,390	76	409,640
30" RCP	LF	880	30	26,400
Catch Basin Type A	Ea	16	1,000	16,000
Catch Basin Type B	Ea	31	1,300	40,300
Structure Class II	Ea	2	5,700	11,400
Structure Class III	Ea	7	6,600	46,200
Structure Class VI	Ea	9	4,700	42,300
Jacking Pipe	LF	60	250	15,000
Channel 10-ft	LF	13,450	70	941,500
Culvert Structure	Ea	7	25,000	175,000
Pavement Replacement	SY	9,210	15	138,150
Utility Relocation	LS	1	55,000	55,000
				3,865,655

PLAN B

102" Pipe	LF	5,840	189	1,103,760
78" Pipe	LF	4,380	78	341,640
75" Pipe	LF	960	76	72,960
69" Pipe	LF	1,310	72	94,320
63" Pipe	LF	1,330	66	87,780
60" Pipe	LF	1,210	63	76,230
57" Pipe	LF	2,660	61	162,260
51" Pipe	LF	1,420	53	75,260
36" Pipe	LF	605	34	20,570
33" Pipe	LF	565	32	18,080
Evans School Connec. 30" RCP	LF	880	30	26,400
Catch Basin Type A	Ea	16	1,000	16,000
Catch Basin Type B	Ea	27	1,300	35,100
Concrete Struc. Class I	Ea	1	3,500	3,500
Concrete Struc. Class II	Ea	1	5,700	5,700
Concrete Struc. Class III	Ea	4	6,600	26,400
Concrete Struc. Class V	Ea	1	2,000	2,000
Concrete Struc. Class VI	Ea	4	4,700	18,800
Jacking Pipe	LF	60	250	15,000
Pavement Replacement	SY	7,888	15	118,320
Relocated Utilities	LS	1	55,000	55,000
Channel Lining	LF	13,450	70	941,500
Culvert Bridge	Ea	7	25,000	175,000
				3,491,580

SOUTHERN AVENUE LATERAL - PHASE II

Item	Units	Quantity	Unit Cost	Total
			$	$
48" RCP	LF	620	46	28,520
45" RCP	LF	715	45	32,175
42" RCP	LF	270	43	11,610
39" RCP	LF	1,050	38	39,900
Catch Basin Type A	Ea	8	1,000	8,000
Catch Basin Type B	Ea	3	1,300	3,900
Structure Class I	Ea	1	3,500	3,500
Structure Class IV	Ea	4	900	3,600
Pipe Jacking	LF	75	250	18,750
Pavement Replacement	SY	1,314	15	19,710
Utility Relocation	LS	1	3,000	3,000
				172,665

ALAMEDA LATERAL - PHASE II

63" RCP	LF	1,150	66	75,900
57" RCP	LF	1,470	61	89,670
45" RCP	LF	2,050	45	92,250
36" RCP	LF	600	34	20,400
Catch Basin Type A	Ea	9	1,000	9,000
Catch Basin Type B	Ea	12	1,300	15,600
Catch Basin Type C	Ea	1	1,500	1,500
Structure Class I	Ea	1	3,500	3,500
Structure Class IV	Ea	2	900	1,800
Structure Class V	Ea	2	2,000	4,000
Pipe Jacking	LF	75	250	18,750
Pavement Replacement	SY	2,900	15	43,500
Utility Replacement	LS	1	5,000	5,000
				380,870

RAILROAD LATERAL - PHASE II

Item	Units	Quantity	Unit Cost	Total
			$	$
27" RCP	LF	1,400	29	40,600
5' Manhole	Ea	1	1,000	1,000
Utility Relocation	LS	1	1,000	1,000
				42,600

UNIVERSITY DRIVE LATERAL - PHASE II

54" RCP	LF	660	59	38,940
51" RCP	LF	1,270	53	67,310
48" RCP	LF	650	46	29,900
45" RCP	LF	670	45	30,150
42" RCP	LF	2,675	43	115,025
39" RCP	LF	1,320	38	50,160
30" RCP	LF	2,170	30	65,100
24" RCP	LF	3,130	28	87,640
18" RCP	LF	525	16	8,400
Catch Basin Type A	Ea	33	1,000	33,000
Catch Basin Type B	Ea	13	1,300	16,900
Structure Class I	Ea	4	3,500	14,000
Structure Class IV	Ea	6	900	5,400
Structure Class V	Ea	1	2,000	2,000
Pavement Replacement	SY	4,031	15	60,465
Utility Relocation	LS	1	7,000	7,000
				631,390

PRIEST DRIVE LATERAL (BROADWAY-SOUTHERN) - PHASE III

PLAN A OR B

Item	Units	Quantity	Unit Cost	Total
			$	$
87" RCP	LF	1,350	85	114,750
84" RCP	LF	1,250	83	103,750
81" RCP	LF	1,300	81	105,300
78" RCP	LF	1,370	78	106,860
60" RCP	LF	1,310	63	82,530
54" RCP	LF	1,350	59	79,650
48" RCP	LF	1,280	46	58,880
39" RCP	LF	1,350	38	51,300
36" RCP	LF	1,320	34	44,880
Catch Basin Type A	Ea	7	1,000	7,000
Catch Basin Type B	Ea	13	1,300	16,900
Structure Class I	Ea	1	3,500	3,500
Structure Class II	Ea	1	5,700	5,700
Structure Class III	Ea	1	6,600	6,600
Structure Class V	Ea	1	2,000	2,000
Structure Class VI	Ea	2	4,700	9,400
Pavement Replacement	SY	8,082	15	121,230
Utility Relocation	LS	1	11,000	11,000
				931,230

48TH STREET LATERAL - PHASE IV

PLAN A OR B

69" RCP	LF	2,770	72	199,440
66" RCP	LF	520	68	35,360
63" RCP	LF	430	66	28,380
57" RCP	LF	2,625	61	160,125
54" RCP	LF	2,640	59	155,760
42" RCP	LF	2,640	43	113,520
39" RCP	LF	1,370	38	52,060
33" RCP	LF	2,800	32	89,600
27" RCP	LF	1,520	29	44,080
24" RCP	LF	2,880	28	80,640
Catch Basin Type A	Ea	4	1,000	4,000
Catch Basin Type B	Ea	24	1,300	31,200
5' Manhole	Ea	2	1,000	2,000
Structure Class I	Ea	2	3,500	7,000
Structure Class IV	Ea	2	900	1,800
Structure Class V	Ea	6	2,000	12,000
Pipe Jacking	LF	375	250	93,750
Pavement Replacement	SY	6,363	15	95,445
Utility Relocation	LS	1	15,000	15,000
				1,221,160

PRIEST DRIVE LATERAL (SOUTHERN AVE.-SOUTH) - PHASE V

PLAN A AND PLAN B

Item	Units	Quantity	Unit Cost	Total
			$	$
75" RCP	LF	2,060	76	156,560
69" RCP	LF	3,650	72	262,800
63" RCP	LF	1,950	66	128,700
60" RCP	LF	500	63	31,500
51" RCP	LF	1,380	53	73,140
48" RCP	LF	1,330	46	61,180
45" RCP	LF	750	45	33,750
36" RCP	LF	2,690	34	91,460
33" RCP	LF	2,840	32	90,880
30" RCP	LF	2,640	30	79,200
24" RCP	LF	2,660	28	74,480
Catch Basin Type A	Ea	28	1,000	28,000
Catch Basin Type B	Ea	17	1,300	22,100
Structure Class I	Ea	3	3,500	10,500
Structure Class II	Ea	3	5,700	17,100
Structure Class IV	Ea	4	900	3,600
Structure Class V	Ea	2	2,000	4,000
5' Manholes	Ea	1	1,000	1,000
Pipe Jacking	LF	360	250	90,000
Pavement Replacement	SY	3,093	15	46,395
Utility Relocation	LS	1	14,000	14,000
				1,320,345

MILL AVENUE LATERAL - PHASE V

PLAN A

Item	Units	Quantity	Unit Cost	Total
			$	$
54" RCP	LF	1,380	59	81,420
51" RCP	LF	700	53	37,100
45" RCP	LF	960	45	43,200
39" RCP	LF	440	38	16,720
36" RCP	LF	2,400	34	81,600
Catch Basin Type A	Ea	8	1,000	8,000
Catch Basin Type B	Ea	7	1,300	9,100
Concrete Structure Class I	Ea	1	3,500	3,500
Concrete Structure Class IV	Ea	1	900	900
Jacking Pipe	LF	100	250	25,000
Pavement Replacement	SY	1,300	15	19,500
Utility Relocation	LS	1	3,000	3,000
				329,040

PLAN B

51" RCP	LF	700	53	37,100
45" RCP	LF	960	45	43,200
39" RCP	LF	440	38	16,720
36" RCP	LF	1,200	34	40,800
Catch Basin Type A	Ea	8	1,000	8,000
Catch Basin Type B	Ea	7	1,300	9,100
Concrete Structure Class I	Ea	1	3,500	3,500
Concrete Structure Class IV	Ea	1	900	900
Jacking Pipe	LF	100	250	25,000
Pavement Replacement	SY	1,300	15	19,500
Utility Relocation	LS	1	3,000	3,000
				206,820

OPTION - Common to both Plan A and B

36" RCP	LF	2,550	34	86,700
Concrete Structure Class I	Ea	1	3,500	3,500
Concrete Structure Class IV	Ea	1	900	900
Pavement Replacement	SY	600	15	9,000
				100,100

PLAN B ONLY

18" Pressure Main	LF	4,000	16	64,000
Concrete Structure Class I	Ea	2	3,500	7,000
Jacking Pipe	LF	250	250	62,500
				133,500

APPENDIX B

Alternate No. 5 (See Sketch on Page 16):

This method is similar to Alternate No. 3 in that it provides for the on-site drainage of the Freeway for a 50-year return frequency storm. Assuming the possibility of a cooperative venture with the City of Tempe, we will join our system to the proposed City storm drain which was designed to drain 330 acres on a two-year return frequency. If this system is used it is anticipated that arrangements can be made to drain the detention basin into the future City storm drain system.

This study includes the following requirements:

a. Enlargement of the existing storage basin.

b. The installation of a pump plant at Rural Road, at McClintock Road and at Price Road.

c. A gravity storm drain from the Tempe Canal to the existing detention basin.

d. The existing pump plant will be retained to drain the basin into the Western Canal. Under the present agreement of a maximum rate of 500 gallons per minute it would take approximately thirty days to drain the basin. This will be a temporary arrangement (see "e" below).

e. A new pumping plant with a greater capacity will be required at the detention basin after the City's storm drain is installed.

Estimated cost for this construction:

Item	Quantity	Unit Cost	Total Cost
24" RCP	400'	$ 15.00	$ 6,000
42" RCP	1,000'	33.00	33,000
54" RCP	1,000'	48.00	48,000
60" RCP	2,000'	54.00	108,000
66" RCP	2,000'	59.00	118,000
72" RCP	3,000'	66.00	198,000
84" RCP	4,000'	85.00	340,000
96" RCP	3,900'	108.00	421,000
Roadway Drainage	12,400'	18.25	226,000
Pumping Plants	3	200,000	600,000
Storage Excavation	642,750 cy	1.50	964,000

TOTAL: (Pumping plant to City outfall not incl. - ±$150,000) $3,062,000

--From Arizona Highway Department

The advantages of Alternate No. 5 are:

1. Advantages to the Arizona Highway Department:

   a. Provides an outlet for the detention basin by utilization of the proposed City trunk line along Western Canal, via 56th Street to the Salt River.

   b. Reduces the chance for conflicting grade lines at College Avenue, between the City of Tempe system and the Arizona Highway Department system.

   c. The frequency of flooding at Kyrene Road will be slightly reduced.

2. Advantages to the City of Tempe:

   a. Reduced pipe size from College Avenue to 56th Street.

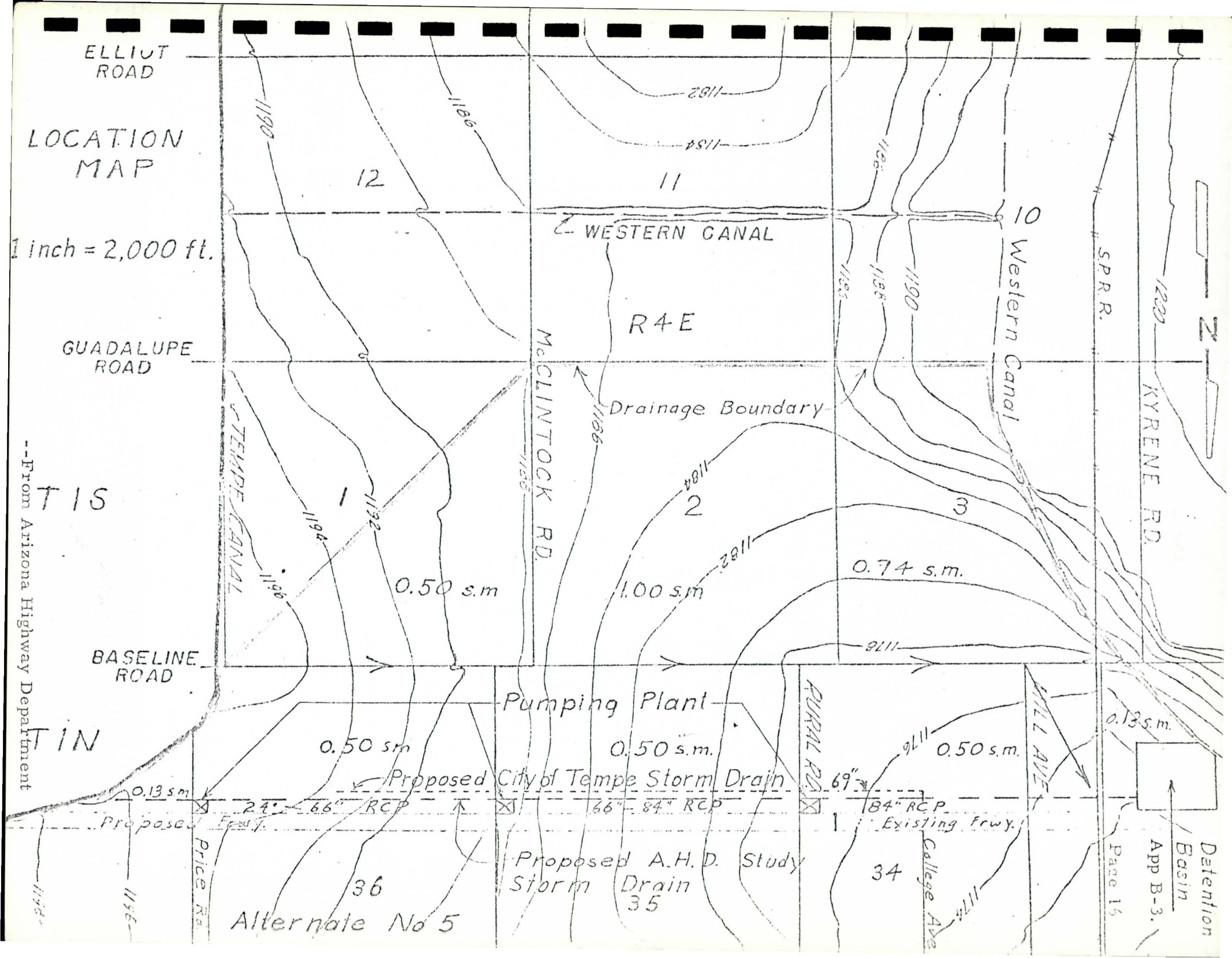
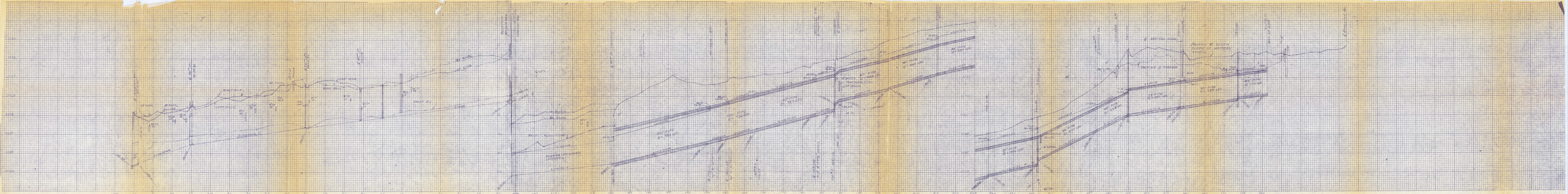
   b. Reduced pipe size of the trunk line down 56th Street to the Salt River.

The disadvantages of Alternate No. 5 are:

1. Will not provide protection from off-site flows. As for the existing highway, flooding can be anticipated at Kyrene Road and the Southern Pacific tracks.

2. Coordination and a cooperative agreement with the City of Tempe are essential. By their very nature, such arrangements are very complex and time consuming.

--From Arizona Highway Department



--From Arizona Highway Department