

**FLOOD DAMAGE REPORT
STORM & FLOOD OF SEPT. 4-6, 1970
CITY OF PHOENIX, ARIZONA**

ENGINEERING DEPARTMENT

JAMES E. ATTEBERY

CITY ENGINEER

FEBRUARY 1971

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FLOOD DAMAGE REPORT

STORM & FLOOD OF SEPT. 4-6, 1970

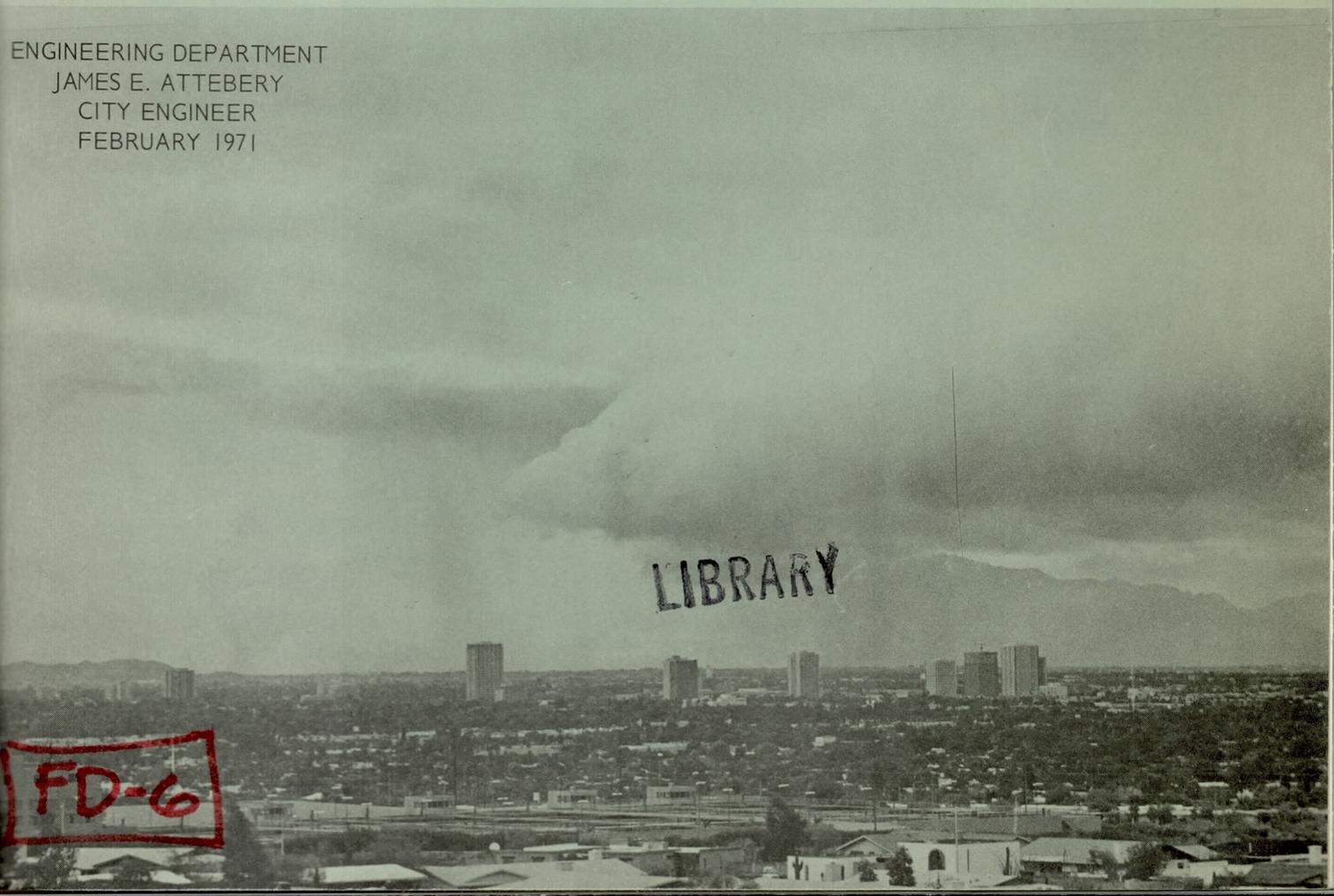
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Bob Ingram	U.S. Weather Bureau
Mark Stragier	City of Scottsdale
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Storm Damage Report
Storm of September 4, 5, & 6, 1970

SCOPE

This report describes the storm, flood, and resultant damage to the City of Phoenix and certain portions of the City of Scottsdale where joint problems occurred during the period of September 4, 5 and 6, 1970.

GENERAL DESCRIPTION

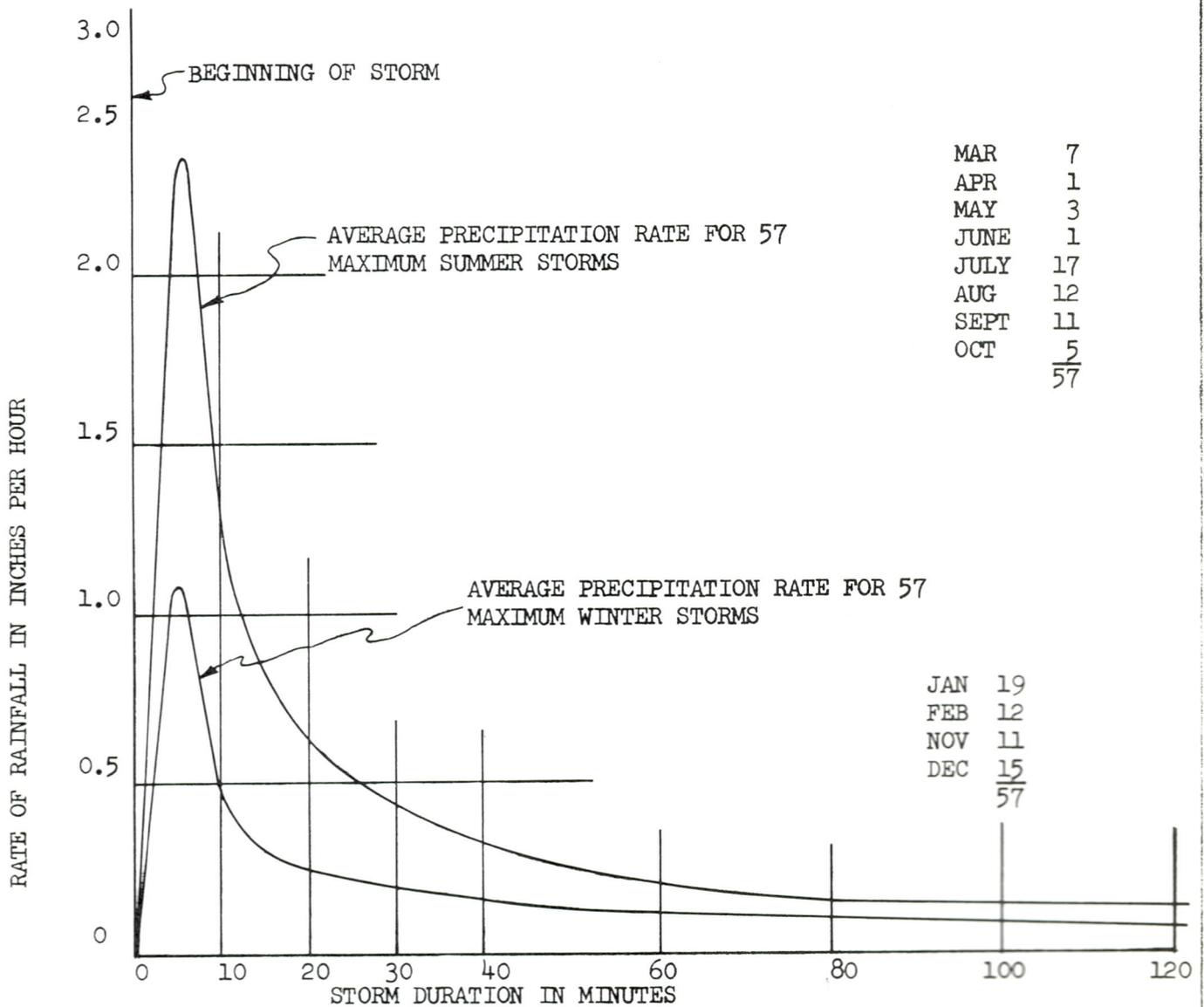
Phoenix is an unusual city in several respects. It is a desert city, located on what can best be described as a desert flood plain. Local precipitation is generally very light; the average annual rainfall being about 8 inches. The manner in which this precipitation occurs is of some interest, since the majority of problems are caused by the short, intense, summer thunderstorms localized in a relatively small area. The chart on the following page illustrates the rainfall rate patterns in Phoenix.

Drainage in the area is primarily sheet flow, although some well-defined natural washes exist at the higher elevations. The origins of the City were primarily agricultural, so an extensive network of above-ground canals was constructed to facilitate irrigation of adjoining fields. The canals were constructed running at right angles to the normal direction of storm water flow. Increasing urbanization has further disturbed the natural pattern of sheet flow and has created a situation in which the damage of property by floods is quite extensive and costly. Although the likelihood of a flood such as occurred in 1891 is quite remote due to the dams on the Salt River, the urbanization, coupled with above ground canals acting as diversion structures, has created a situation which makes the City susceptible to local flood damage.

METEOROLOGY

A description of the meteorology of this storm was obtained from the U.S. Weather Bureau at Sky Harbor and condensed for use in this report.

On the 1st of September, 1970, tropical storm Norma, located in the Pacific Ocean, south of Baja, California, initiated a flow of warm, moist, air toward the desert southwest. This moist air entered Arizona on the 2nd of September and increased in depth over the next two days. On the afternoon of the 3rd of September, it reached sufficient depth to develop thunderstorms in the southeastern part of the state, which gradually spread into the Phoenix area on the evening of the third. On the morning of the 4th, heavy precipitation fell in some areas of the southern portion of the state. This precipitation ended by late evening on the 4th.



PHOENIX RAINFALL RATE PATTERN

In the early morning of September 5th, a cold front was located in southwestern Utah, extending southwesterly into southern Nevada. A deep upper trough was associated with this front while a surface trough was oriented from Las Vegas, Nevada to Palm Springs California, ahead of the cold front. Orographically induced rainfall increased sharply as the upper trough and the surface trough advanced from the west.

By midafternoon the surface trough, along with normal daytime heating had generated several lines of thunderstorms in the deserts of western Arizona. These gradually advanced eastward accounting for the late afternoon and early evening precipitation maximums in the Phoenix area. (A photo on page 4 is a dramatic example of the type of storm that passed over the area.) As the evening wore on, the westerly push weakened and the surface trough took on the characteristics of a cold front, then moved slowly southward and dissipated.

Rainfall data shown on subsequent pages, with the exception of the weather bureau station at Sky Harbor, is from unofficial sources. The reliability of the sources is quite good. The majority of the stations are maintained by present or past U.S. Weather Bureau employees, and most of the gauges were supplied by the U.S. Weather Bureau.



PHOTO # 1

STORM CLOUDS OVER PHOENIX

ARIZONA REPUBLIC



PHOTO # 2

INTERSECTION AT 14TH AVENUE AND GLENDALE ARIZONA REPUBLIC

ESSA STATION AT
SKY HARBOR AIRPORT RAINFALL

TOTALS BY THE HOUR

<u>Sept. 4, 1970</u>		<u>Sept. 5, 1970</u>	
<u>Hours</u>	<u>Amount</u>	<u>Hours</u>	<u>Amount</u>
1 - 2 a.m.	Trace	11 - 12	Trace
2 - 3 a.m.	.05	12 - 13 p.m.	.02
3 - 4 a.m.	.08	13 - 14 p.m.	.36
4 - 5 a.m.	.02	14 - 15 p.m.	.05
5 - 6 a.m.	.01	15 - 16 p.m.	.33
6 - 7 a.m.	Trace	16 - 17 p.m.	.64
7 - 8 a.m.	Trace	17 - 18 p.m.	.17
8 - 9 a.m.	Trace	18 - 19 p.m.	.17
9 - 10 a.m.	Trace	19 - 20 p.m.	.16
10 thru 17	0	20 - 21 p.m.	.35
17 - 18	Trace	21 - 22 p.m.	.09
18 - 19	Trace	22 - 23 p.m.	Trace
19 - 24	0	23 - 24	.03
 <u>Sept. 5, 1970</u>		 <u>Sept. 6, 1970</u>	
<u>Hours</u>	<u>Amount</u>	<u>Hours</u>	<u>Amount</u>
0 - 1 a.m.	Trace	0 - 1	Trace
1 - 2 a.m.	Trace	10 - 11	Trace
2 - 6 a.m.	Trace	11 - 12	Trace
6 - 7 a.m.	.03	<u>Excessive Precipitation</u>	
7 - 8 a.m.	.02	<u>5 Min.</u>	<u>10 Min.</u>
8 - 9 a.m.	Trace	.30''	.42''
9 - 10 a.m.	.01	<u>15 Min.</u>	<u>20 Min.</u>
10 - 11 a.m.	Trace	.48''	.52''
		<u>30 Min.</u>	<u>60 Min.</u>
		.63''	.92''
		<u>80 Min.</u>	<u>100 Min.</u>
		1.00''	1.05''
		<u>120 Min.</u>	<u>150 Min.</u>
		1.09''	1.20''
		<u>180 Min.</u>	<u>180 Min.</u>
		1.30''	1.30''

UNOFFICIAL
 RAINFALL TOTALS FOR STORM OF
 September 4, 5, and 6, 1970

	<u>Total</u>		<u>Total</u>
Deer Valley	2.29''	Carefree	3.30''
Scottsdale	3.57''	51st Ave. & Virginia	2.10''
54th St. - Lafayette Blvd.	4.0''	36th St. & Altadena	1.99''
12th & Weldon	3.0''	24th St. & Ind. Sch. Rd.	3.18''
36th St. & Ind. Sch. Rd.	3.86''	W. Sunnyslope	2.26''
32nd St. & Ind. Sch. Rd.	3.60''	Paradise Valley	3.74''
8059 E. Cambridge	3.60''	64th St. & Oak	3.84''
2215 E. Nancy Lane	2.80''	7th St. & Baseline	2.28''
4331 E. Broadway	2.4''	W. Phoenix	1.97''
4203 E. McDowell	3.85''	E. Scottsdale	3.94''
Guadalupe	1.52''	W. Scottsdale	3.68''
Granite Reef Dam	2.52''	36th St. & Picadilly	3.67''
Mummy Mt. (Groene)	4.15''	63rd Ave. & Ind. Sch. Rd.	1.68''
Lake Pleasant	4.11''	Daily Park - Tempe	1.90''
Litchfield Park	4.65''	Sky Harbor Airport	2.59''
Buckeye	4.65''	3rd Ave. & Holly	3.00''
Maricopa	1.16''		

Recurrence interval of the overall storm would be difficult to establish since a network of recording rain gauges does not exist in the city. Point rainfall in the Scottsdale area exceeded the 100 year, 24 hour storm, while point rainfall in parts of west Phoenix was less than a 5 year, 24 hour, recurrence interval. Figure 1 is an isoheytal map of the storm.

The geographical extent of the storm was quite large, covering much of the state, with individual cells in the storm providing greater precipitation in localized areas. Many rainfall records were exceeded, the most spectacular being 11.40 inches in a 24 hour period in the Sierra Ancha Mountains. This is nearly double the previous record in the state of 6.0 inches at Crown King.

RUNOFF

Measurement of runoff is difficult in most of the Phoenix area due to the absence of well defined natural channels, and the absence of metering devices on the large storm drains. U.S. Geological Surveys estimates were obtained for the following channels:

Cave Creek Wash at Bell Road (see photo on page 10) - 1500 cfs

Indian Bend Wash at Indian Bend Road - 1100 cfs

Salt River at 48th Street - 4800 cfs

Further information received from the City of Scottsdale provided the following information:

The Salt River Valley Water Users Association released approximately 2000 cfs into Indian Bend Wash at the Arizona Canal; at Indian Bend Wash and Thomas Road local runoff had increased this flow to 5000 cfs. In the alley parallel to the Arizona Canal, between 56th Street and 72nd Street, flow was estimated at 500 - 600 cfs. Flood stage in this alley is 160 cfs.

By inspection of figure 1, the average rainfall in the City of Phoenix was approximately 2.75" with a total rainfall volume of approximately 36,226 acre feet.

FLOODED AREA

Sheet flow occurred throughout the City of Phoenix, running generally from Northeast to Southwest. Generally, water was carried by the streets, and the drainage system functioned well; however, local property damage occurred in several areas, usually associated with the Grand and Arizona Canals.

Runoff from the Camelback Mountain area drained into the alley running along the Arizona Canal between 56th Street and 72nd Street, and caused considerable property damage as it flowed westerly to the Falls Substation where part of the flow drained into the Canal with the rest crossing the Canal over the 56th Street Bridge and causing damage to the south.



PHOTO # 3

BELL ROAD AT CAVE CREEK WASH

ARIZONA REPUBLIC



PHOTO # 4

3RD STREET AND ROOSEVELT

ARIZONA REPUBLIC

According to eyewitness reports from City of Phoenix and City of Scottsdale personnel, the Arizona Canal overflowed its banks approximately 3'' - 4'' deep for a distance of 300' to 400' on the bank northeast of 64th Street. As the flow continued to the west in the alley, it flowed back into the Canal in some areas between 60th and 64th Streets.

Water overflowed the south bank of the Arizona Canal from the 900 block west to the 1300 block west and flooded several homes between the Canal and Northern Avenue, and overflowed the north bank just east of 7th Avenue, flooding 6 homes.

Flood damage occurred north of the Arizona canal in the Hatcher Road and Carol Avenue area, damaging several homes and businesses, due to water flowing in from the Sunnyslope area.

Additional flooding associated with the Arizona Canal occurred in the area south of the spillway at 39th Street, many homes were flooded in an area from 36th Street to 40th Street, from Campbell to the Arizona Canal as water spilled from the Canal.

Flooding and property damage occurred in numerous areas along the Grand Canal, from 19th Avenue west, due to ponding behind the embankment.

Several businesses were flooded in the vicinity of 48th Street and Melvin as water flowed west from Papago Park; however, damage was slight.

Flooded homes were reported along Broadway, from 20th Street, west to Central.

As can be seen from figure 2, portions of the City were sheet flooded, with the streets carrying the water. Fully improved streets, with storm drains handled the flow well, but some drainage problems occurred at intersections. A large number of intersections had deep water, with some overflow of curb and gutter, but little or no property damage. Generally, only in depressions and behind large obstructions did sufficient ponding occur to cause property damage.

FLOOD DAMAGE ESTIMATE

Field work in this area included interviewing officials of various governmental agencies and private citizens who could supply reliable information as to damages from the storm.

For convenience, the damage is divided into groups according to land use and each type of damage is described.

Residential Damage

The value of homes flooded varied from \$50,000 in the Arcadia area to \$14,000 in the Maryvale area. Most of the homes damaged were 10 years old or older, although some recently-built condominiums on Dunlap Avenue were flooded.



PHOTO # 5

16TH STREET AND CAMELBACK

ARIZONA REPUBLIC



PHOTO # 6

7TH STREET AND WILLETTA

ARIZONA REPUBLIC

LEGEND:

○ - FLOODED AREA

■ - AREA WHERE HOUSES WERE FLOODED

FLOODED AREAS

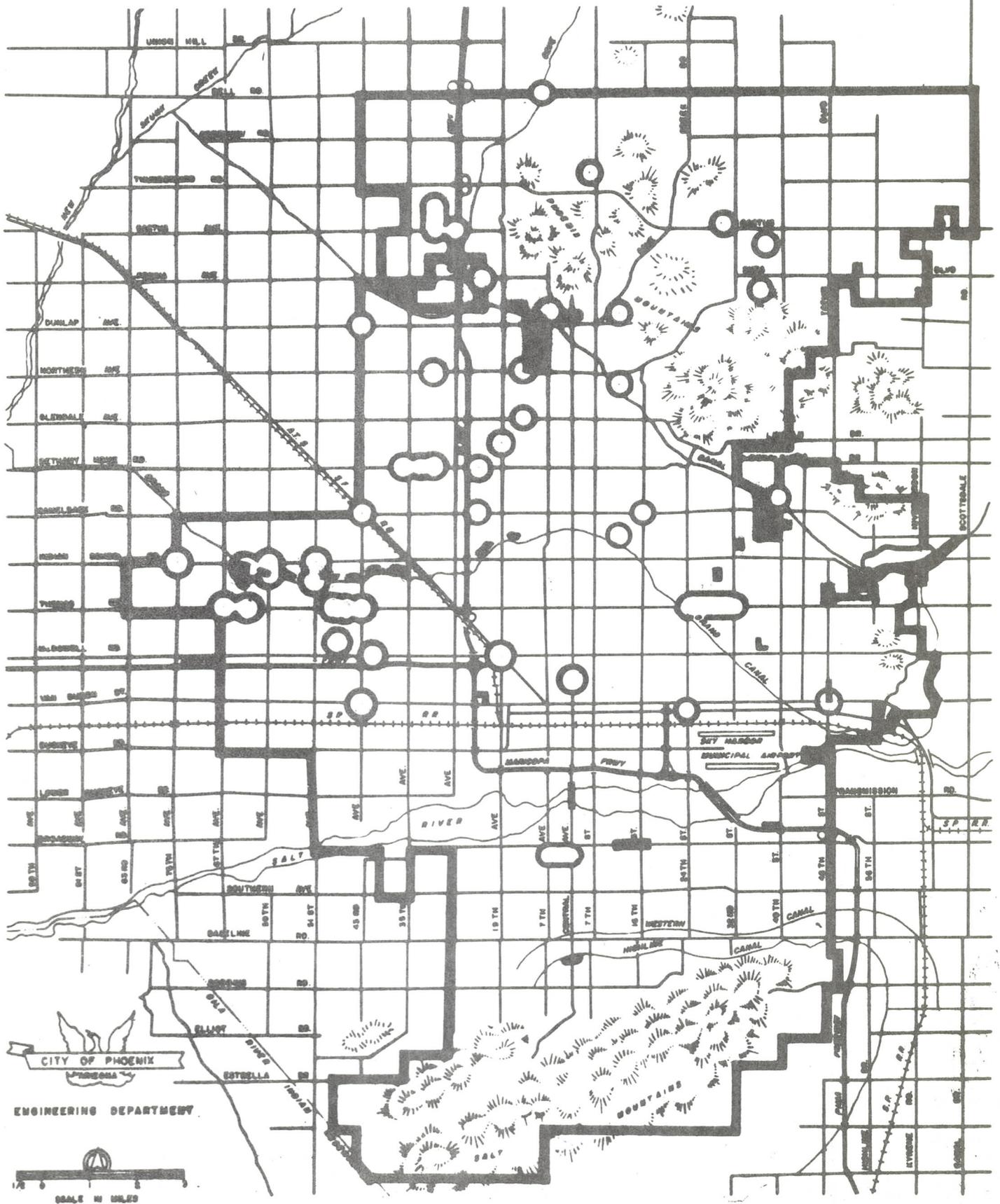


Figure 2

Almost all damage was due to inundation as flow velocities were low in most instances. Silt deposition was generally not excessive, although in some streets 2'' - 3'' of silt was deposited. Generally lawns and gardens were not damaged by the flows. Damage varied widely, even in adjoining homes in homogeneous subdivisions due to varying floor elevations. In areas where developers have elevated floor elevations little or no damage was incurred.

Flood damage insurance is generally not available, although a federal program is proposed, in Phoenix and none of the homeowners were insured. Physical damage occurred to carpets, furniture, baseboards, drywalls, floor tiles, paint, automobiles and appliances. Also swimming pools were contaminated by storm runoff, silt and debris.

Based on estimates from field emergency personnel of the City of Phoenix, the total number of homes experiencing flooding during this storm is approximately 200.

Commercial and Industrial Damage

Commercial and industrial damage from this storm was very light. Field personnel report a total of 16 businesses that sustained flooding. In all reported instances the inundation was very shallow, generally 6'' or less. Types of businesses involved were light manufacturing, service industries, convenience markets, construction companies, filling stations, print shops, and office buildings. Stores suffered only minor physical damage and small loss of stock. Cleanup and business loss were the major part of the damage and these damages were minor due to rapid draining off ponds as soon as the rain stopped. (There were no applications to the Small Business Administration for flood damage loans by businesses due to this storm from Phoenix citizens.) Additional expenses were incurred by several firms using employees to prevent the floodwaters from entering their place of business.

Damage to Utilities, Streets and Highways

Damage of this type was fairly extensive. It includes damage to water production facilities including: Damage to pump houses, pumps, bearings, valves, access roads, and additional chemicals due to the muddy waters that flowed into water treatment plants at Squaw Peak and the Verde River. Total cost of these damages is estimated at \$14,470.

A major expense was incurred due to the undermining of 400 feet of the multi-city sewer line in the Salt River bed. Estimated cost of repair of the sewer line is in excess of \$100,000.

Streets suffered damages estimated at \$11,391.76. Primarily, these damages consisted of pavement breakup, undermining of pavement, and silting of streets. An additional \$5,450 was estimated as the cost of working City Maintenance crews overtime to cope with emergency repairs.



PHOTO # 7

48TH STREET, VAN BUREN TO MELVIN

ARIZONA REPUBLIC



PHOTO # 8

19TH AVENUE, MCDOWELL AND GRAND AVENUE

ARIZONA REPUBLIC

Public Property Damage

According to local officials some flooding occurred at Ingleside School, but caused no damage other than mud cleanup. Classes were not interrupted as the flooding occurred during a school holiday.

Damage estimated at \$32,361 was incurred at the Litchfield Park Airport. Primarily damage was limited to a drainage canal which was heavily eroded when the banks collapsed in places. The perimeter road and fence were also damaged, as was the south overrun of the runway.

Irrigation Facilities

Limited information was available as to the extent of damages suffered by the Salt River Project. A lawsuit is pending at the time of this writing against the Project, so limited information concerning the Labor Day storm is available. Sixty-one thousand six hundred forty-seven dollars was expended to repair diversion works, Canals, and laterals. No breakdown of expenditures within the City of Phoenix was supplied. However, the City's portion was only a small percentage of the total.

**Summary of Damages From the Flood of September 4, 5 and 6, 1970
for the City of Phoenix, Arizona**

DAMAGES

Type of Loss	Physical Damage	Emergency Costs	Totals
Residential	\$400,000	\$20,000	\$420,000
Commercial & Industrial	0	8,000	8,000
Utilities	100,000	14,470	114,470
Streets	11,392	3,074	14,466
Public Property	34,000	0	34,000
		Total	\$590,936

Loss of Life

No loss of life occurred in the City of Phoenix, but 8 lives were lost in Maricopa County and 23 were lost Statewide. All deaths were due to drowning, no traffic fatalities were attributable to the storm.

Damage Summary

Damage estimates were arrived at through actual records of individuals and agencies or by noting the nature of damages in the field and applying unit costs later. It is highly probable that the total estimate of approximately \$600,000 is lower than that actually incurred as there is always a certain percentage of damage that goes unreported, as in the commercial damage that was unreported to the Small Business Administration.

Damage in Phoenix was slight when compared with the havoc wrought in the rest of Maricopa County and the State as a whole. Maricopa County damage estimate was \$5,803,342 with eight lives lost due to drowning. When you consider that the largest concentration of population, with the greatest potential for damage loss in the County, sustained only 10% of the total damage some credit should be given to the Phoenix Storm Drainage System.

With the sketchy data available, it is difficult to assign a recurrence interval of this storm. The maximum intensity over a 3 hour period (the time of concentration for our largest sewers) was no more than a 5 year storm. In total rainfall it was more than a 100 year storm. There can be no doubt that it was a major storm in the Phoenix area, and both the above and below ground drainage systems functioned well.