File

CITY OF MESA

MESA, ARIZONA

STORM DRAINAGE REPORT

APRIL 1961

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E. J. BROWN

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CITY ATTORNEY

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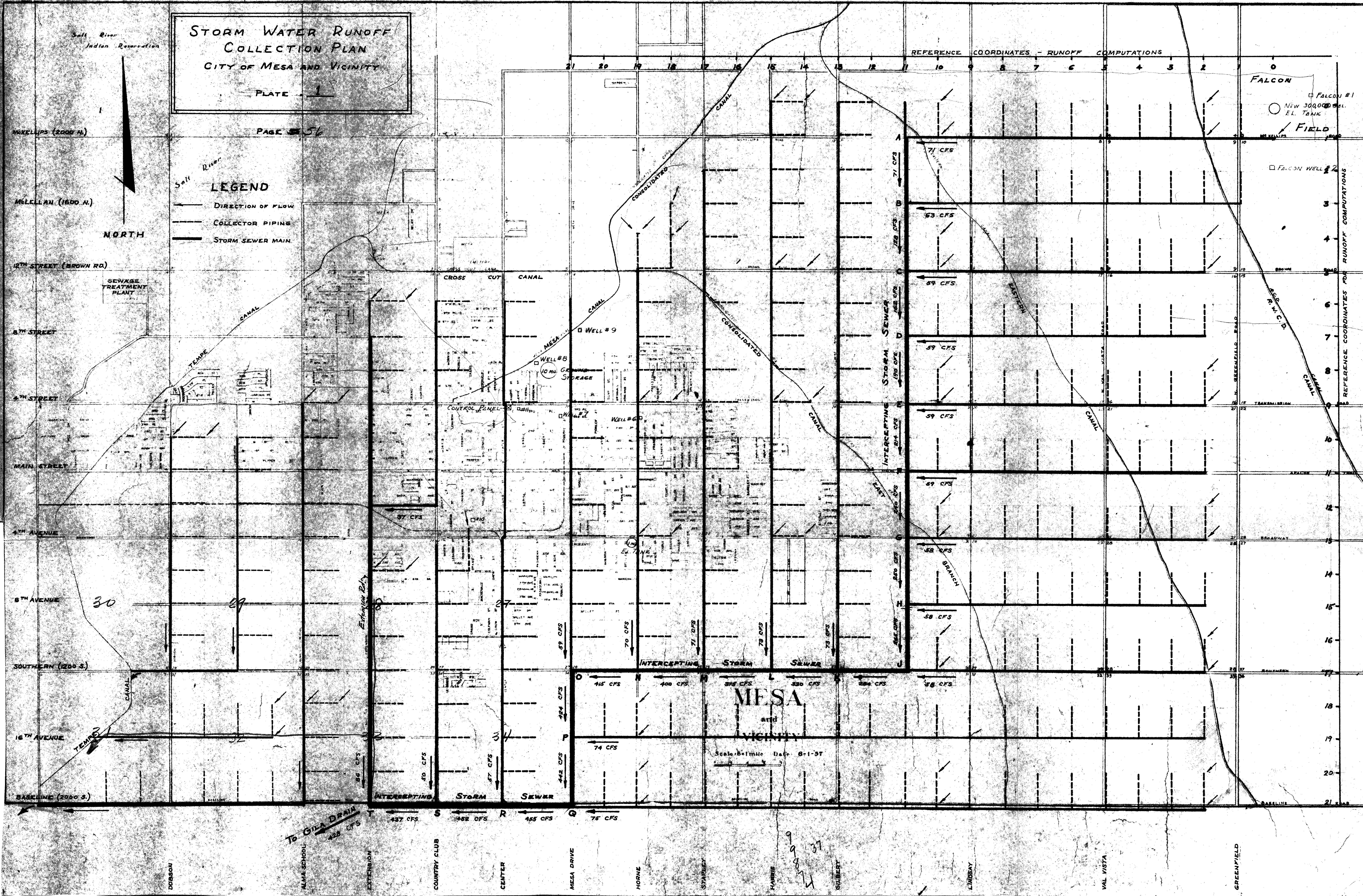
SUPERINTENDENT OF STREETS AND CITY ENGINEER

CHARLES K. LUSTER



STORM WATER RUNOFF
COLLECTION PLAN
CITY OF MESA AND VICINITY
PLATE 1
PAGE 56
Salt River Indian Reservation
NORTH
LEGEND
Direction of flow
Collector piping
Storm sewer main
REFERENCE COORDINATES - RUNOFF COMPUTATIONS
REFERENCE COORDINATES FOR RUNOFF COMPUTATIONS
McKELLIPS (2000 N.)
McLELLAN (1600 N.)
12TH STREET (BROWN RD.)
8TH STREET
4TH STREET
MAIN STREET
4TH AVENUE
8TH AVENUE
SOUTHERN (1200 S.)
16TH AVENUE
BASELINE (2000 S.)
SEWAGE TREATMENT PLANT
TEMPE CANAL
CROSS CUT CANAL
MESA CANAL
CONSOLIDATED CANAL
EASTERN CANAL
EAST BRANCH
R.W.C.D. CANAL
WELL #9
WELL #8
10 MG GROUND STORAGE
CONTROL PANEL
WELL #10
EL. TANK
FALCON FIELD
FALCON #1
NEW 300,000 GAL. EL. TANK
FALCON WELL #2
INTERCEPTING STORM SEWER
71 CFS
63 CFS
89 CFS
59 CFS
58 CFS
57 CFS
415 CFS
400 CFS
230 CFS
74 CFS
424 CFS
442 CFS
427 CFS
452 CFS
465 CFS
75 CFS
TO GILA DRAIN
428 CFS
MESA and VICINITY
DOBSON
ALMA SCHOOL
EXTENSION
COUNTRY CLUB
CENTER
MESA DRIVE
HORNE
STAPLEY
HARRIS
GILBERT
LINDSAY
VAL VISTA
GREENFIELD
HIGLEY ROAD

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THE DRAINAGE AREA

The maximum possible storm water runoff rate per acre for any given locality is related directly to the maximum rainfall intensity that may be expected. Actual runoff rates may be far less than the maximum possible or may come very close to it. How close the actual runoff rates come to the maximum possible, depends upon such things as the shape of the drainage area, the slope and capacity of the drainage area, and the permeability of its surfaces.

A. DESCRIPTION OF THE CITY OF MESA AND VICINITY:

The City of Mesa and vicinity possesses one very peculiar drainage characteristic. Although located in very close proximity to the Salt River, the natural slope and drainage from the Mesa Area is to the Southwest toward the Gila River.

Mesa is part of a drainage area which is bounded on the North by a bluff that roughly parallells the Salt River Channel. The crest of this bluff represents the divide between drainage to the Salt River and drainage toward the Gila River. For this reason, Mesa is not faced with the problem of handling runoff from another drainage area.

The Mesa area is comprised of relatively uniform and gentle slopes to the South and West. Refer to Figures 1 and 2 for section line profiles.

B. ARTIFICIAL BARRIERS

The canal system, especially the western canal and the Consolidated canal, represents a barrier to any drainage system, natural or man made water channels. In general it is not possible for the western and consolidated canals to intercept storm runoff. This is due to the canals being built up high to ficilitate serving irrigation water to the adjacent lands. For this reason the storm sewers will be required to "under cross" the canals.

CITY OF MESA & VICINITY
STORM DRAIN REPORT

PROFILES ALONG SECTION LINES
FROM
McKELLIPS RD. TO BASELINE RD.

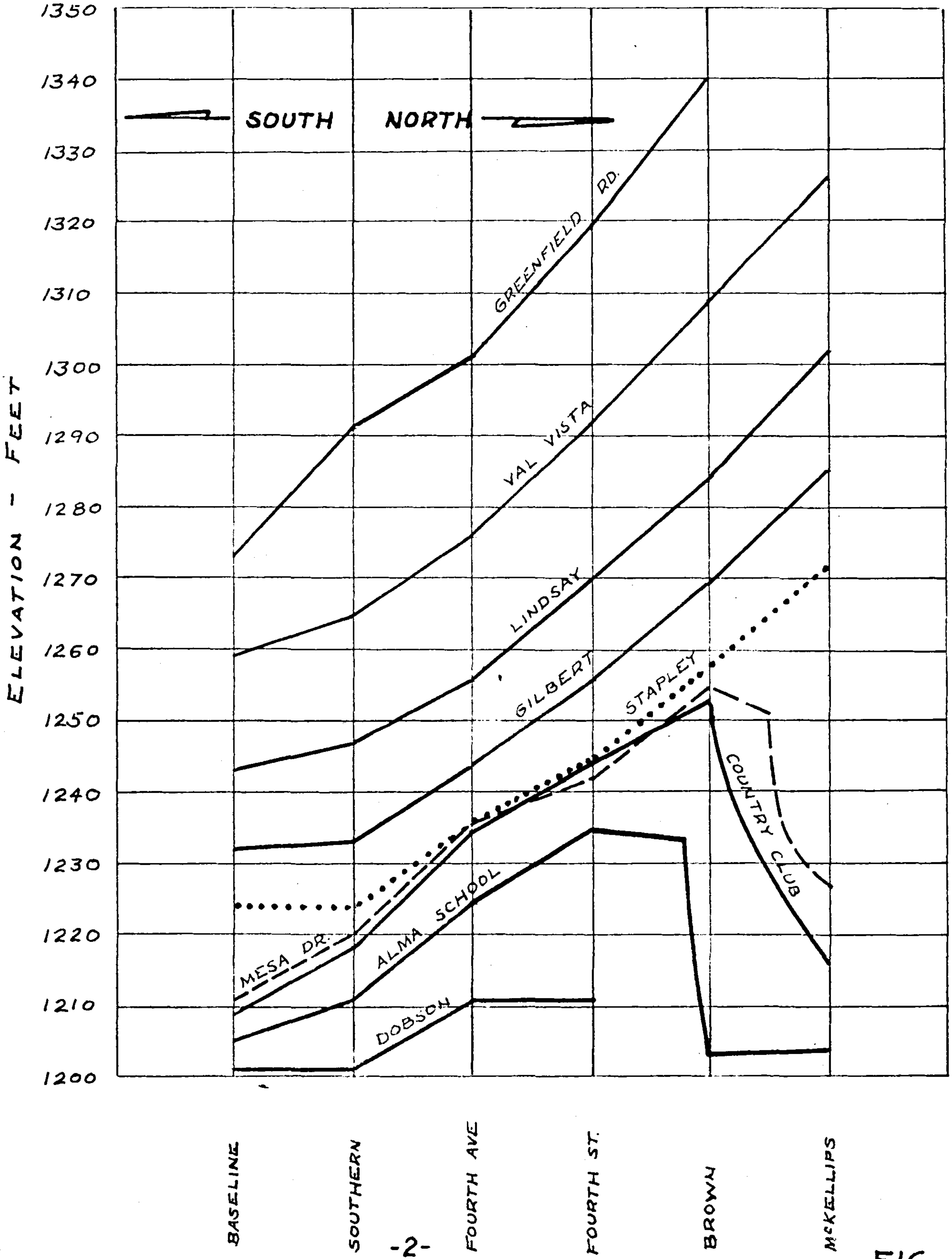


FIG. 1

CITY OF MESA & VICINITY
STORM DRAIN REPORT

PROFILES ALONG SECTION LINES
FROM
DOBSON RD. TO GREENFIELD RD.

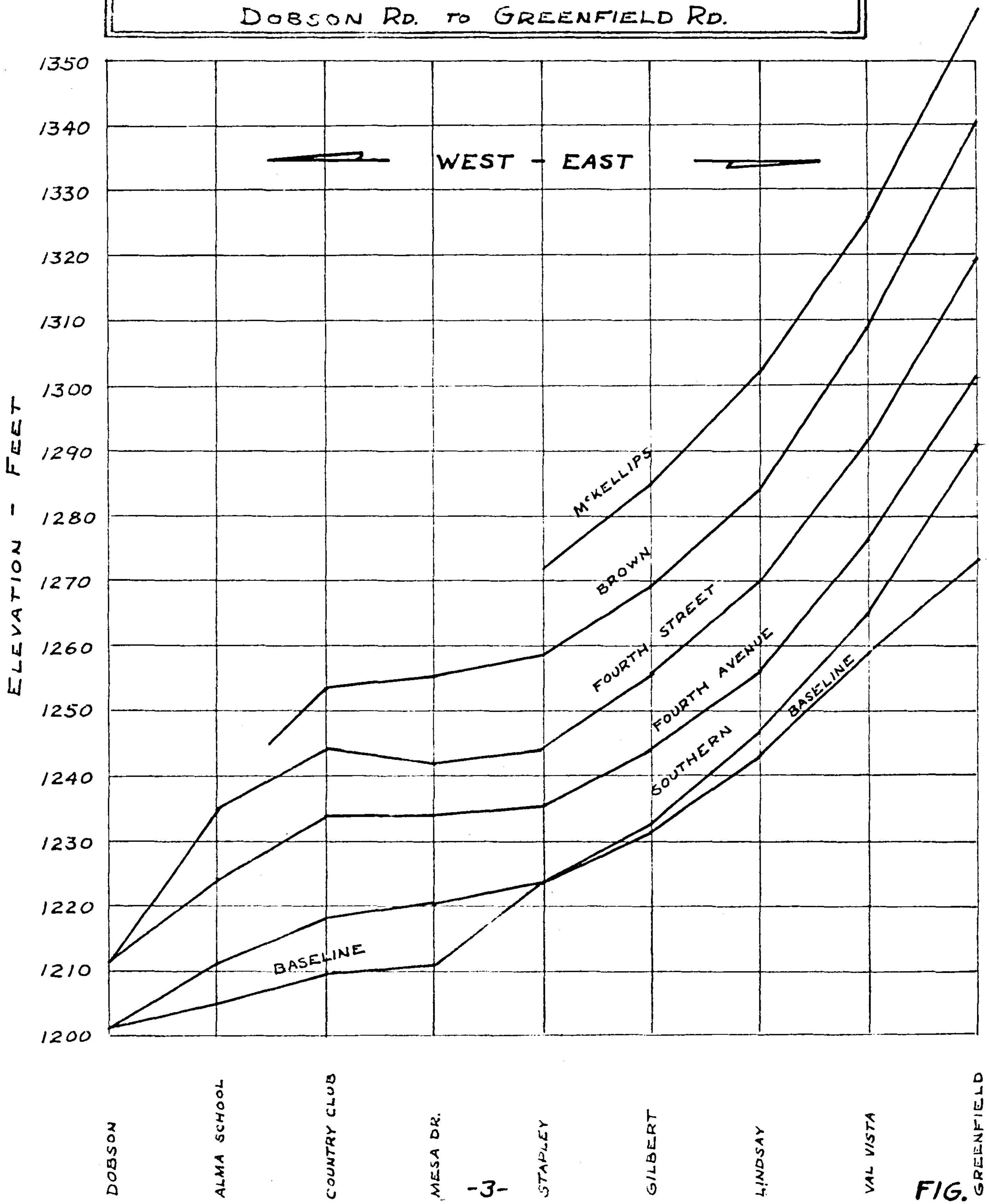


FIG. 2

HYDROLOGY

Arizona and the Mesa Vicinity receive very little annual rainfall; however, there are two relatively rainy periods in the year. Refer to Figure 3 AVERAGE MONTHLY RAINFALL. The two rainy periods are characterized by storms of distinctly different types. The winter storms are usually of low intensity and relatively long duration. The summer storms are often of high intensity and usually of short duration. Refer to Figure 4, MAXIMUM RECORDED RAINFALL INTENSITIES.

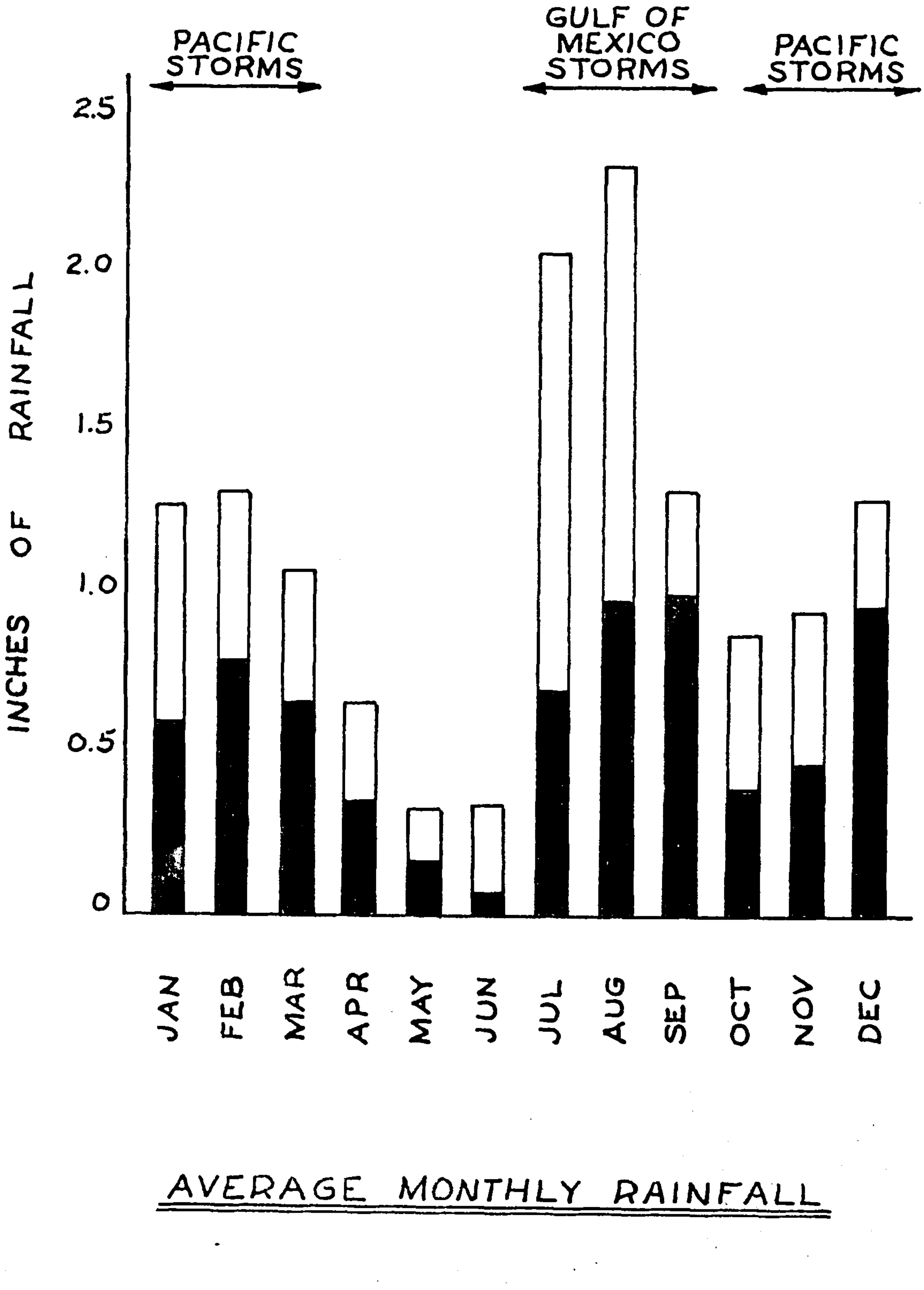
Storm drainage systems are designed to conduct water away rather than to store it. For this reason, a storm of high intensity imposes more severe demands on the drains than a more gentle storm even if the latter results in greater total rainfall.

A. PRECIPITATION

1. RAINFALL INTENSITY: In the Mesa area high rainfall intensity rates do not continue for long periods, there being an inverse relation between rainfall intensity and storm duration. Refer to Figure 5 RELATION BETWEEN MAXIMUM RECORDED RAINFALL INTENSITY AND DURATION. The maximum rainfall intensitities for five minute and ten minute durations are shown on Figure 4 MAXIMUM RECORDED RAINFALL INTENSITIES.

Storms of high intensity do not occur every year. A storm of an intensity that occurs on the average of once every other year (it is generally not practical or economical to design for the maximum possible storm). Refer to Figure 6 RAINFALL INTENSITY-DURATION-FREQUENCY CURVES.

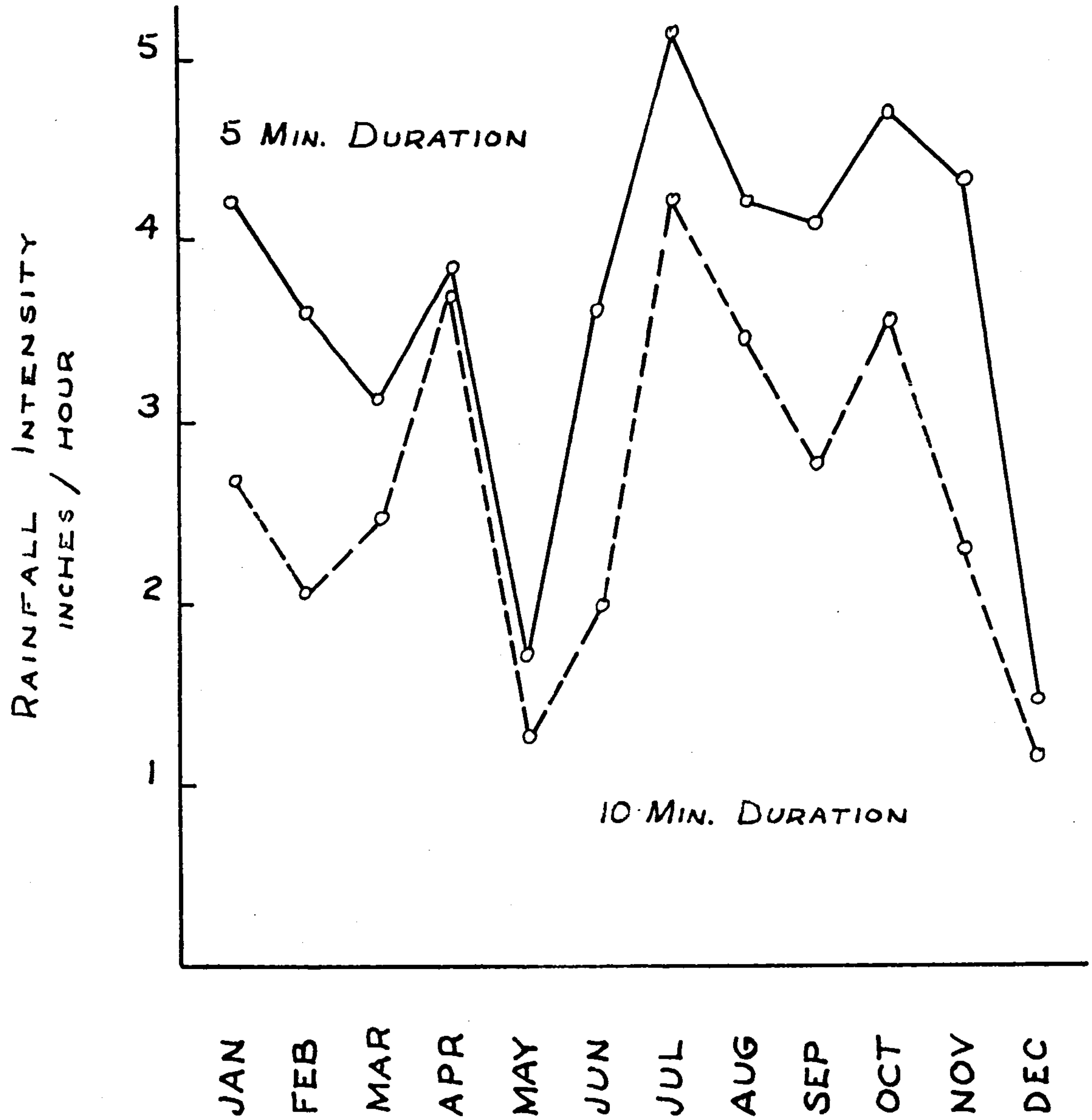
2. AREAL EXTENT OF STORMS: The phrase "Scattered showers" is often used in summertime weather forecasts. In the summertime it is often possible to see several high intensity rainstorms occurring simultaneously with wide spaces of sunlight between them. Summertime rainstorms are typically of small areal extent and when large areas receive rain from



AVERAGE MONTHLY RAINFALL

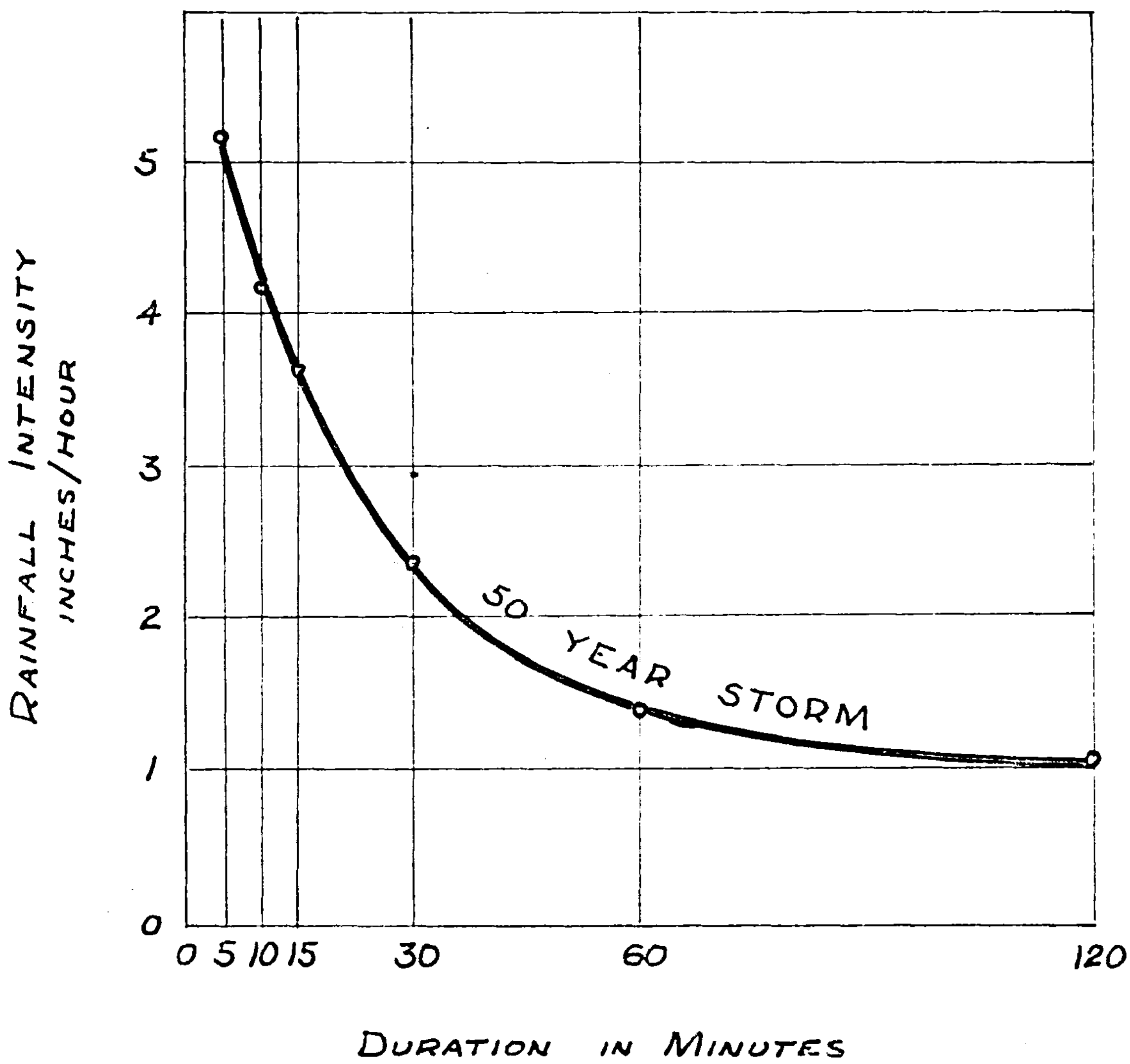
SHADED BARS FOR CITY OF MESA & VICINITY
UNSHADED BARS FOR STATE OF ARIZONA

FIG. 3



MAXIMUM RECORDED RAINFALL INTENSITIES
AT PHOENIX POST OFFICE
PERIOD 1903-1955

FIG. 4



RELATION BETWEEN MAXIMUM RECORDED RAINFALL INTENSITY AND DURATION
FROM PHOENIX WEATHER BUREAU RECORDS
PERIOD 1903-1955

FIG. 5

DESIGN CURVES

RAINFALL INTENSITY - DURATION - FREQUENCY

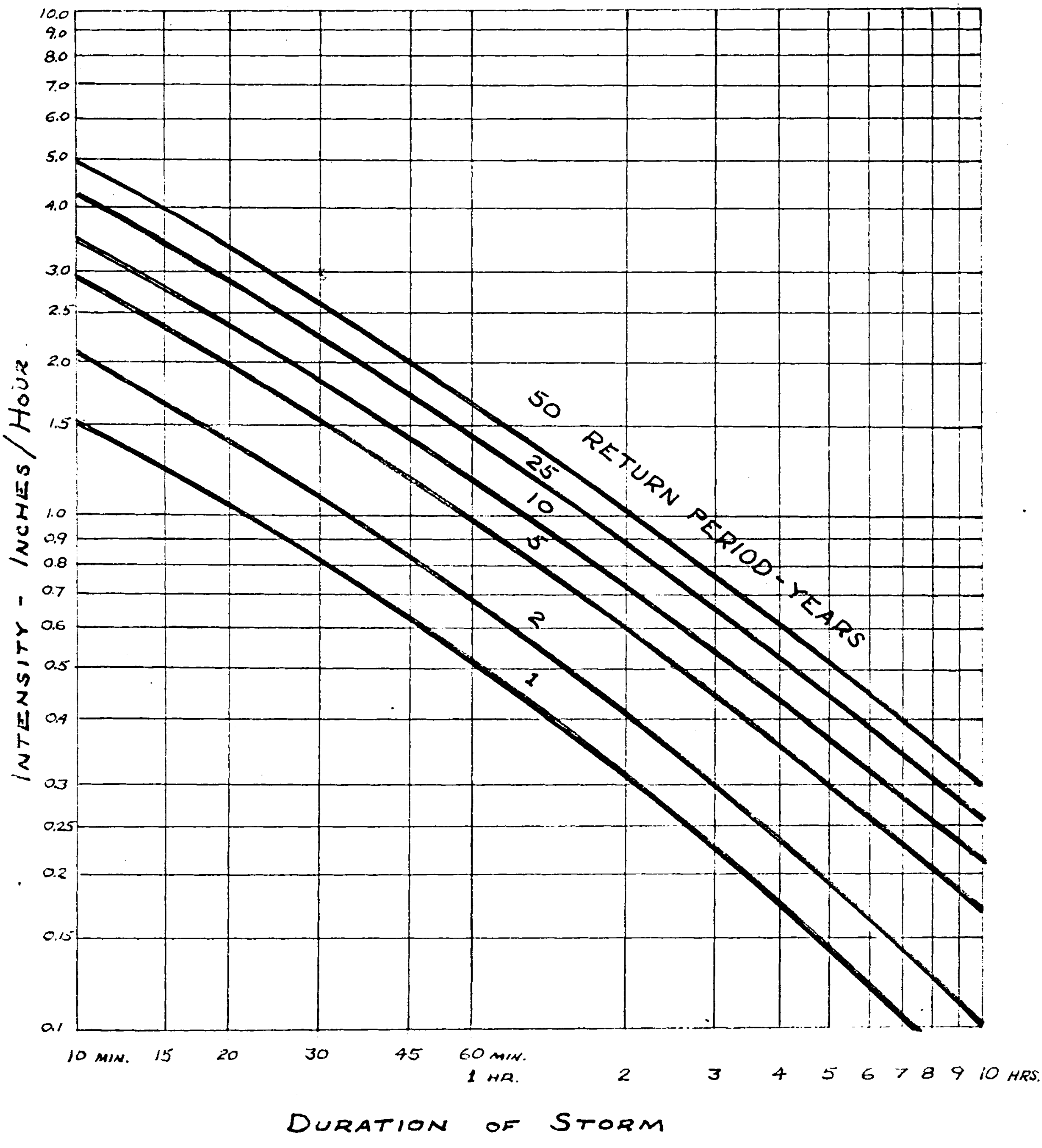


FIG. 6

DESIGN AREA - DEPTH CURVE

(FOR LOCAL STORMS)

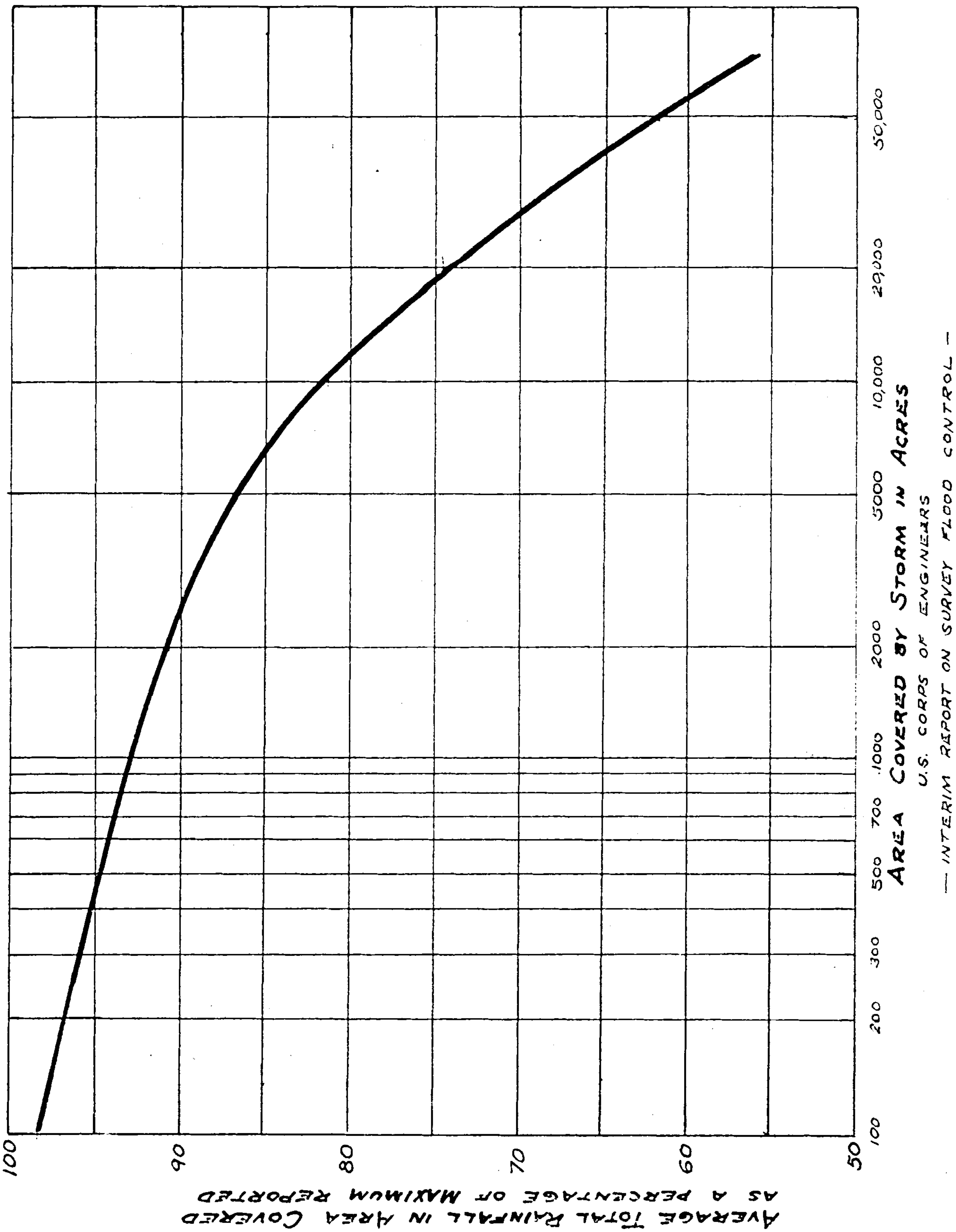


FIG. 7

such storms it is because there are many of them.

Winter storms are of lower intensity and cover much larger areas. Refer to Figure 4 MAXIMUM RECORDED RAINFALL INTENSITIES.

The relation between rainfall in the area covered by the storm to the area covered is shown in Figure 7. This curve was prepared by the Corps of Engineers in a report entitled "Interim Report of Survey-Flood Control for Tucson, Arizona, dated November 20, 1945". This curve shall be used in connection with computing runoff in this report.

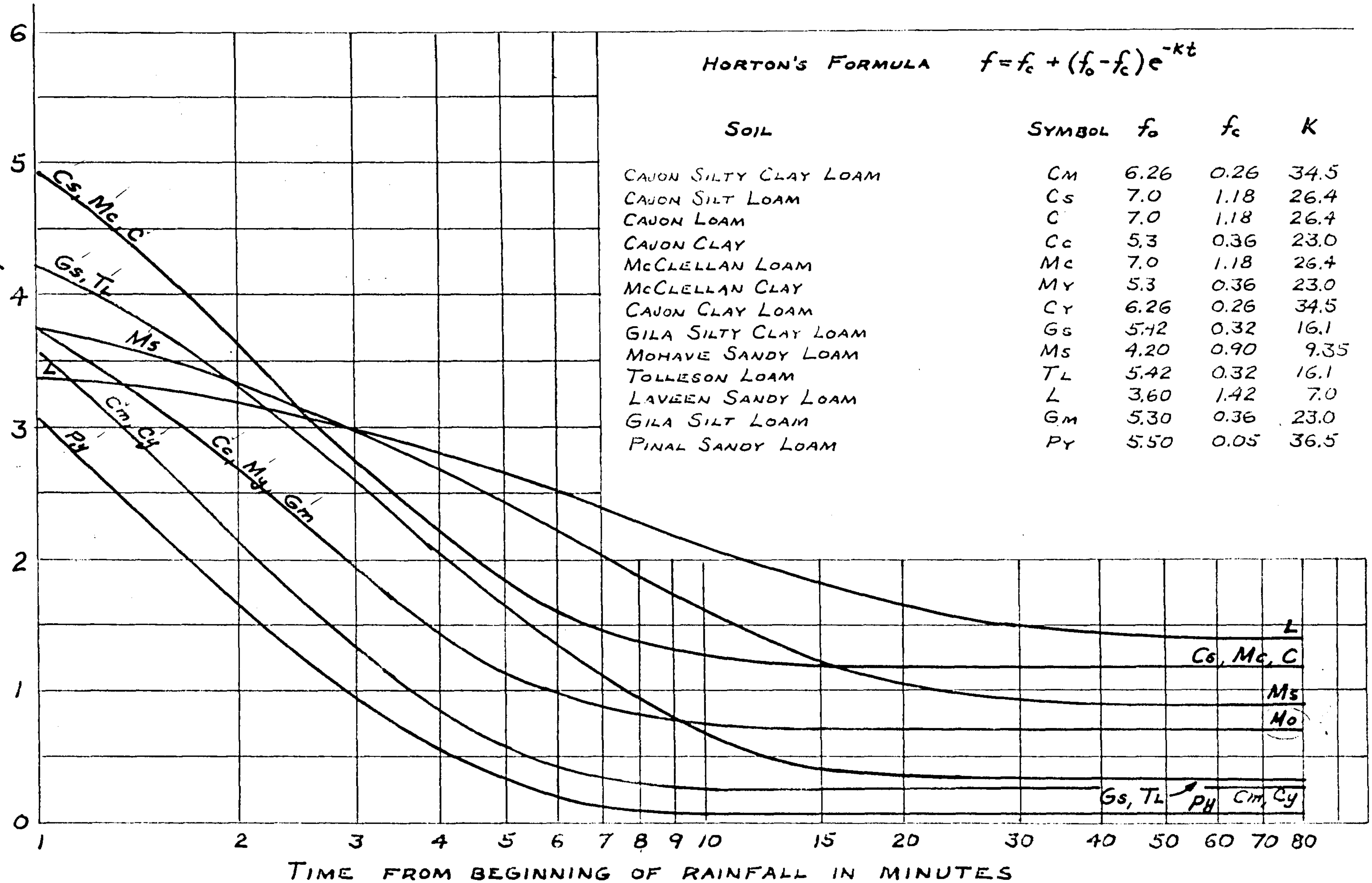
B. INFILTRATION AND OTHER LOSSES

Not all the rain that reaches the earth becomes runoff. Some is returned immediately to the atmosphere by evaporation, some is retained in depressions to evaporate later, some infiltrates into the soil, and some is retained in channels and on surfaces to produce the hydrostatic conditions neceaaary to make flow take place. These losses are actually to the designer's advantage because they reduce the requirements of the drainage system.

1. INFILTRATION IN NATURAL SOIL: A formula has been developed by Dr. R. E. Horton to represent the infiltration capacity of soils and to determine its variation with previous infiltration and time. Horton's formula and constants are shown in Figure 8. The plotted curves of Horton's formula in Figure 8 show that the initial infiltration capacity of a soil is relatively high, that it falls quickly as rainfall continues, and that it approaches a much lower constant rate regardless of the length of storm.

2. OTHER LOSSES: In addition to the water lost by infiltration into the soil, other losses are present even on surfaces normally considered impervious. Some water falling on hot pavement is immediately evaporated. Some water will be lost through cracks in the pavement and in the gutter. Some water finds its way into the sanitary sewer other underground utilities. Finally there is the water required to wet all water carrying surfaces

INFILTRATION RATE - TIME RELATION



HORTON'S FORMULA $f = f_c + (f_o - f_c)e^{-kt}$

SOIL	SYMBOL	f_o	f_c	K
CAJON SILTY CLAY LOAM	CM	6.26	0.26	34.5
CAJON SILT LOAM	CS	7.0	1.18	26.4
CAJON LOAM	C	7.0	1.18	26.4
CAJON CLAY	CC	5.3	0.36	23.0
MCCLELLAN LOAM	MC	7.0	1.18	26.4
MCCLELLAN CLAY	MY	5.3	0.36	23.0
CAJON CLAY LOAM	CY	6.26	0.26	34.5
GILA SILTY CLAY LOAM	GS	5.42	0.32	16.1
MOHAVE SANDY LOAM	MS	4.20	0.90	9.35
TOLLESON LOAM	TL	5.42	0.32	16.1
LAVEEN SANDY LOAM	L	3.60	1.42	7.0
GILA SILT LOAM	GM	5.30	0.36	23.0
PINAL SANDY LOAM	PY	5.50	0.05	36.5

FIG. 8

and in all channels to produce the proper hydrostatic conditions for flow to take place.

Each of these losses might seem to be of minor importance but the cumulative result is well worth taking advantage of in the design of storm drains.

It is assumed that this loss on impervious surfaces amounts to ten percent of the rainfall.

C. RUNOFF

The first requirement in designing a storm drainage system is usually to determine the runoff of storm water it will be necessary for the system to handle at various points along its length. The runoff of storm water is expressed as a rate since it is rates rather than total quantities that effect the sizing of components of the drainage system.

Rain falls at a certain rate over a drainage area and flows over surfaces and through channels to a point where it is discharged from the area. The rate of discharge cannot be greater than the rate of supply unless there is temporary storage that could be suddenly released, a condition not likely to be found in a storm drainage system.

The rate of discharge can however be lower than the rate of supply, first, in case there is another outlet, or second, if there is temporary storage and gradual release after the supply ceases. Both of these conditions are likely to be found in any storm drainage system. The OTHER OUTLET is provided by various losses already discussed. TEMPORARY STORAGE as provided by the surfaces and waterways themselves which must contain water in order to transport it.

If the rate of supply were equal to the rate of runoff, if there were no losses or temporary storage, the relation between supply and runoff could be expressed by the relation:

$$Q = IA \tag{1}$$

Q Rate of runoff, cubic feet per second
I Rate of Rainfall, inches per hour
A Drainage area, in acres

In order to account for losses it is necessary to consider the relative amounts of previous and impervious surface and the loss by infiltration in the previous area. Equation (1) then becomes

$$Q = IA_i + (I - F_c) \ A_p \tag{2}$$

A_i impervious area, acres

A_p Pervious area, acres

F_c Infiltration rate for the soil.

It now becomes necessary to discuss concentration time and to show how it affects the value of I_a in equation 3. In any drainage area, a certain period of time (concentration time) is required for water to flow from the most remote point in the area to the outlet. This period of time depends upon the type of water carrying channels, the length of the channels and the slope. When the concentration time for a given drainage area has been determined this time is used to determine the rainfall intensity to be used. The inverse relation between length of storm and rainfall intensity has been discussed previously. In any given drainage area, the maximum runoff rate condition is likely to occur when the area undergoes a storm of duration equal to the concentration time of this area. A storm of longer duration would be less intense and would result in a lower peak runoff rate. A storm of shorter duration than the concentration time of the area is not likely to produce such a high runoff rate even though the rainfall intensity may be higher because the entire drainage area does not begin to contribute at the point of discharge by the time the rain has stopped. The rainfall intensity is taken from the design curves in Figure 6 for the concentration time or a shorter time if a shorter time produces higher runoff. The intensity obtained from Figure 6 may be reduced by an area factor taken from Figure 7. This reduced value of rainfall intensity is I_a (Average rainfall intensity) of Equation 3.

A study of the pervious areas found in Mesa residential sections, along with observations made during rainstorms and a review of the curb and gutter design commonly used in Mesa indicates that no appreciable storm water runoff is derived from pervious lawn areas. Many lawns are provided with berms for flood-type irrigation and in many instances the top of curb has been built slightly above the existing grade.

Any runoff from pervious areas resulting from a one or two year reoccurring storm shall not be considered in this report in computing the runoff rates.

The whole term is then multiplied by a factor of (0.9) to account for the losses on impervious surfaces which is a function of intensity as discussed previously. The following formula will be used in this report in computing runoff rates.

$$Q = 0.9 A_i I_a \qquad (3)$$

Q Runoff rate, cubic feet per second

A_i Impervious area, acres

I_a Average rainfall intensity over area, inches per hour.

A program is now being conducted in the Salt River Valley by the U. S. Geological Survey to gather information concerning rainfall and runoff. Several locations have been selected for detailed study as well as the addition of a number of new rainfall gages throughout the Salt River Valley. When this information is made available by the U. S. Geological survey it should provide a means of checking Formula 3. If necessary, the equation used in this report to compute runoff may then be modified. At the present time, data for this locality is not available which correlates rainfall intensity and the drainage area with the runoff that may be expected.

DESIGN CRITERIA

The purpose of this section of the report is to discuss and recommend certain design standards for use in planning the system. Some of these standards will be based upon judgement or the limited information available at the present time.

A. DESIGN STORM FREQUENCY

In selecting the design storm to compute runoff rates several factors must be taken into consideration. It is necessary to decide if the storm sewers shall be designed to handle the worst storm likely to occur once a year, every five years, every ten years or some other period. The design curves shown in figure 6 indicate that a storm which occurs once every 50 years is likely to be more severe than one occurring every year.

Usually the reasons for a storm sewer system include "reducing flood damage" and/or "reducing a nuisance". Little record of flood damage exists in the Mesa area, however, as more area is developed the potentialities of flood damage are increased. As more and more area is developed with the resulting added runoff the nuisance caused by storm water runoff becomes more serious.

It is usually not economical or practical to design storm sewers for the most severe storms that are likely to occur. Also, it is unreasonable to design for less than a storm likely to occur once each year. In this report, the storm likely to occur every year is used to compute expected runoff rates.

B. SURFACE DRAINAGE ON STREET PAVEMENTS

Street pavements play an important role in storm drainage. Street pavements represent for the most part the impervious portion of the drainage area. As discussed previously under the heading of "Runoff" very little runoff is expected from the pervious portions of the drainage area.

This report is primarily concerned with the storm water runoff from the street pavement areas. Street pavements should be depended upon to carry water to a point at which the cumulative runoff exeeds the capacity of the street. From this point, pipe lines should be constructed to carry the runoff.

A study of the City of Mesa standard street cross-sections indicates each 40 acre drainage area, consisting of approximately 10 acres of impervious street pavements is shown in Figure 9 and 10. For increased runoff capacity, some cities have used streets with an inverted crown. They seem to serve this purpose very well but not without certain disadvantages. In streets with an inverted crown storm runoff is a hinderance to traffic and will result in the entry of water and grit into sanitary sewer manholes located in the inverted crown section of the roadway.

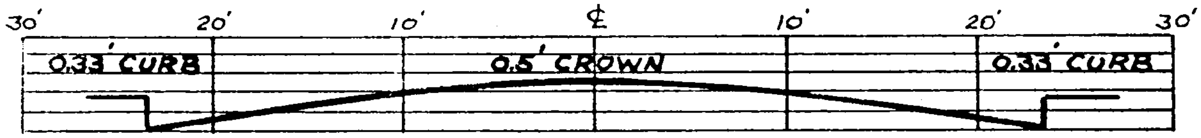
Under certain conditions street pavements with an inverted crown may be used to advantage to provide the necessary capacity to conduct storm water to the nearest inlet into the storm sewer.

Catch basins are used to provide entry for storm runoff into the storm sewer system. These structures are designed to remove grit from the water before it enters the storm sewer. It is estimated that the standard M-11 catch basin used in Mesa will pass approximately 7 cubic feet per second.

It is advisable to provide adequate catch basin capacity so that the full design capacity of the storm sewer may be utilized.

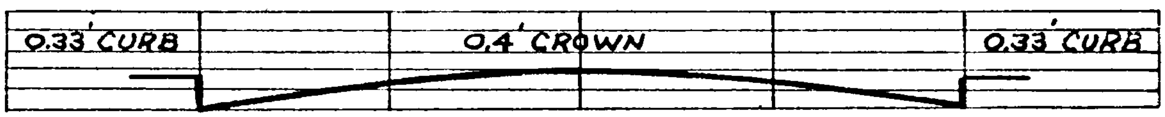
TYPICAL PAVED STREET CROSS-SECTIONS

— FOUR INCH CURBS —



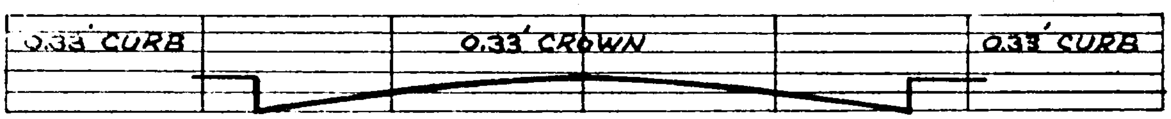
AREA TO TOP OF CURB = 3.24 SQ. FT.
WETTED PERIMETER = 20.66 FT.
HYDRAULIC RADIUS = 0.156

48 FT. COLLECTOR STREET



AREA TO TOP OF CURB = 3.3 SQ. FT.
WETTED PERIMETER = 20.66 FT.
HYDRAULIC RADIUS = 0.16

41 FT. RESIDENTIAL & COLLECTOR STREETS

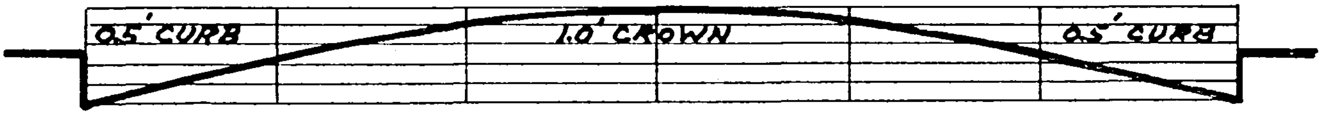


AREA TO TOP OF CURB = 3.75 SQ. FT.
WETTED PERIMETER = 34.70 FT.
HYDRAULIC RADIUS = 0.108

35 FT. RESIDENTIAL STREET

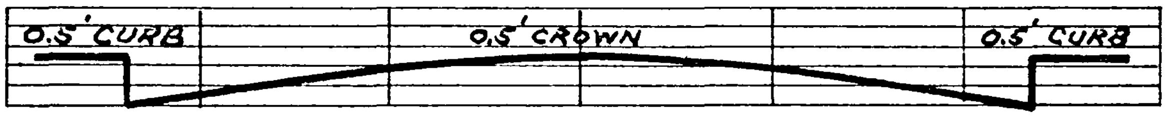
FIG. 9

TYPICAL PAVED STREET CROSS-SECTIONS
— SIX INCH CURBS —



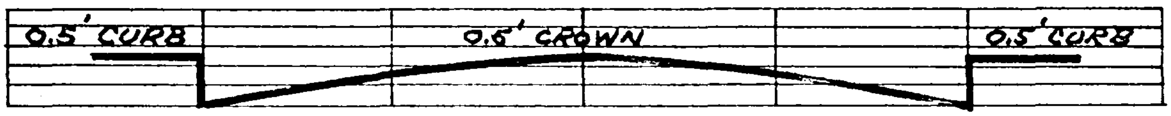
AREA TO TOP OF CURB = 4.5 SQ. FT.
WETTED PERIMETER = 19.0 FT.
HYDRAULIC RADIUS = 0.24

61 FT. ARTERIAL STREET



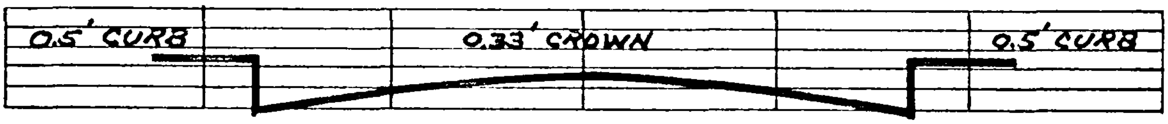
AREA TO TOP OF CURB = 8.5 SQ. FT.
WETTED PERIMETER = 48.0 FT.
HYDRAULIC RADIUS = 0.177

48 FT. COLLECTOR STREET



AREA TO TOP OF CURB = 6.66 SQ. FT.
WETTED PERIMETER = 41.0 FT.
HYDRAULIC RADIUS = 0.16

41 FT. RESIDENTIAL & COLLECTOR STREETS



AREA TO TOP OF CURB = 9.5 SQ. FT.
WETTED PERIMETER = 35.0 FT.
HYDRAULIC RADIUS = 0.27

35 FT. RESIDENTIAL STREET

FIG. 10

C. CRITERIA USED IN COMPUTING RUNOFF

The storm water runoff rates computed in this report are based upon the following criteria:

1. Design storm, "one year" reoccurrence.
2. Impervious area equals 25% of total area.
3. Provide each 40 acre tract with an inlet to the storm sewer.
4. Storm sewer mains located at half mile intervals.
5. Q = 0.9 A; Ia

Item No. 1. It does not seem reasonable to design a storm sewer system for less than a one year storm.

Item No. 2. An estimate of 25% was used in the runoff computations. If the actual percentage of impervious area varies for a given portion of the drainage area the runoff for this area may be adjusted.

Item No. 3. The reason for this requirement is discussed under "Surface drainage on Street pavements".

Item No. 4. Yost and Gardner Engineers determined in their "Phoenix Storm Drainage Report" that half mile intervals is the most suitable and economical layout for storm sewer mains. This report recommends collector pipes be extended to the outlet for each 40 acre tract.

Item No. 5. The runoff relationship used in this report is not substantiated by actual runoff data for this locality. A program to obtain such data is being conducted by the United States Geological Survey and should be available sometime during 1961. The relation used in this report may require revision based upon the U. S. G. S. data.

D. UTILIZATION OF SALT RIVER VALLEY WATER USERS ASSOCIATION

Many of the recommendations and conclusions in this report are predicated upon the use of Salt River Valley Water Users Association laterals and canals for storm drainage.

The Salt River Valley Water Users Association has suggested that the existence of their lateral and canal system may be of great usefulness serving as the nucleus of a storm drainage system in the Mesa area as well as other areas in the Salt River Valley. The existing irrigation system, though not designed to handle storm water runoff, could be modified for that purpose. Heretofore, the Salt River Valley Water Users Association has allowed some storm water connections to their system under a revocable license. In addition to suggesting the use of their irrigation facilities for storm drainage purposes the Salt River Valley Water Users Association has offered to cooperate with the responsible agencies to modify the system to handle storm water runoff.

Modifications to the existing irrigation system will include increasing the capacities of the laterals and structures to handle irrigation and storm water at the same time. The design storm used to compute runoff rates in this report is of such short duration there would not be sufficient time to empty the necessary laterals to provide capacity for storm runoff. Even if there was sufficient time to empty the laterals it would be very difficult to select the proper laterals affected by a particular storm. In addition to these problems it is impractical to stop delivery to laterals of water that has already been discharged from the storage reservoir.

Briefly, through the use of Salt River Valley Water Users Association laterals, canals and existing right-away, where practical, storm water runoff from the Mesa area would be conducted South to canal No. 7, West toward the South Mountains and then South-west to the Gila River.

As discussed previously the natural grade in the Mesa area slopes to the South-west toward the Gila River. To drain runoff to the Salt River would require construction of water channels through the bluff. The profile of North Country Club Drive shown in Figure 11 indicates the prohibitively deep cuts required to construct gravity storm drains North toward the Salt River.

PROFILE
(NORTH ALONG COUNTRY CLUB DRIVE)

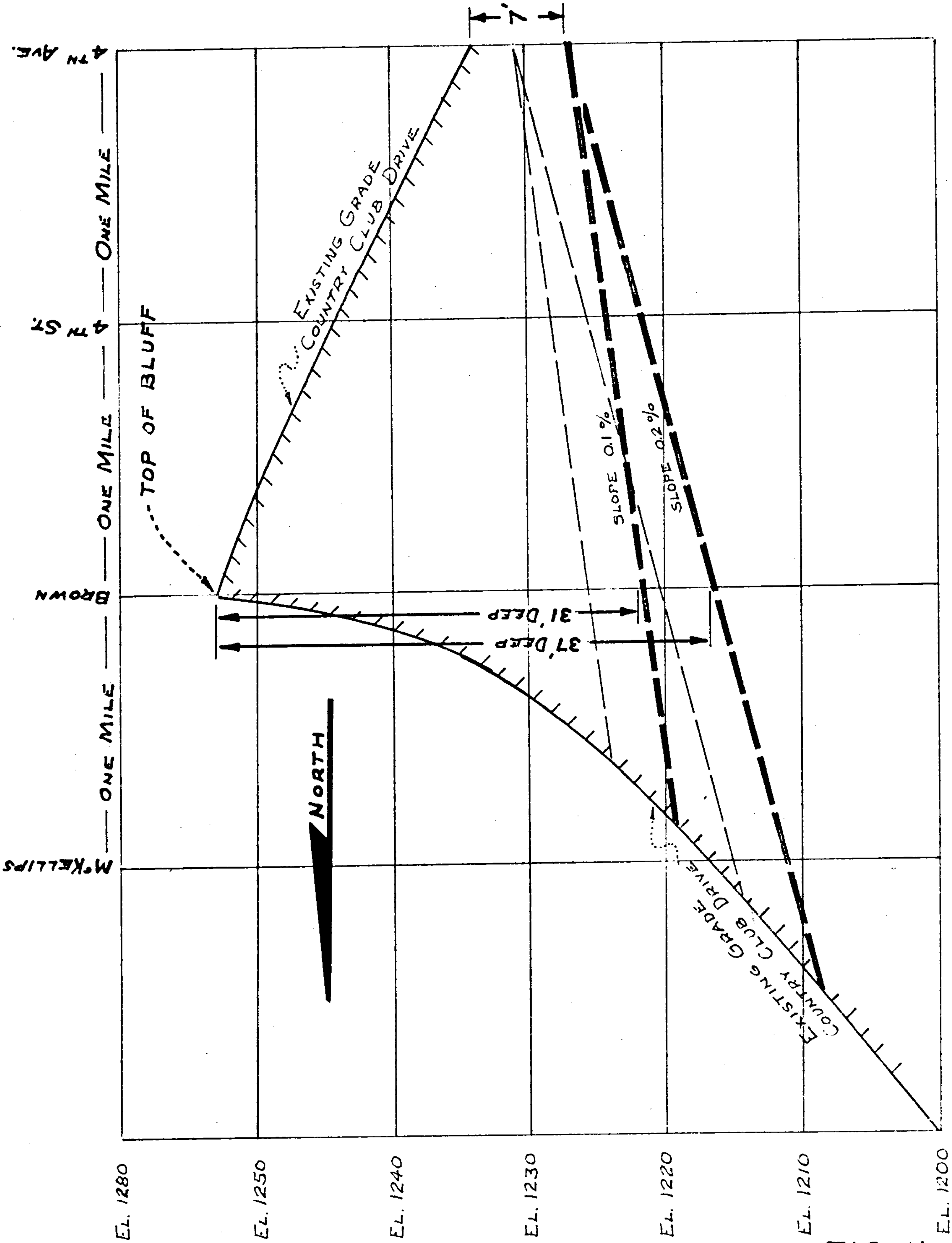


FIG. 11

PROPOSED STORM DRAINAGE PLAN

The master plan for the storm sewer system for the Mesa area involves the use of Salt River Valley Water Users Association laterals, ditches, canals and right-of-way where ever possible.

A. COLLECTION PLAN

The overall storm sewer plans for Mesa and vicinity are shown in Plates 1, 2, and 3. The difference between these plans is in the facilities for disposal of storm water collected in the Mesa area.

All three plans provide for storm sewer mains at half mile intervals with collector piping to pick up storm runoff at the low point of each 40 acre tract of land as shown in Figures 12 and 13.

All storm runoff collected by the storm drainage system East of Extension Road and North of Baseline Road would be routed to Baseline and Extension Roads. From this point the water would proceed along the following route to the Gila River. First South to the Western Canal; then West to the Gila Daain and Southwesterly to the Gila River.

All storm runoff collected by the storm drainage system West of Extension Road and North of Baseline Road would be routed to the Tempe Canal. Runoff received by the Tempe Canal could then be delivered to the Gila Drain which flows to the Gila River.

B. DESIGN FLOWS

The following formula was adopted for the computation of the ruoff rate to be expected from a particular drainage area.

$$Q = 0.9 A_i I_a$$

STORM WATER RUNOFF COLLECTION PLAN

NORTH - SOUTH STORM SEWER MAINS

1. STREET PAVEMENT TO CARRY RUNOFF TO THE LOW POINT OF EACH 40 ACRE DRAINAGE AREA.

2. RUNOFF TO ENTER THE COLLECTOR STORM DRAIN PIPING AT THIS LOW POINT.

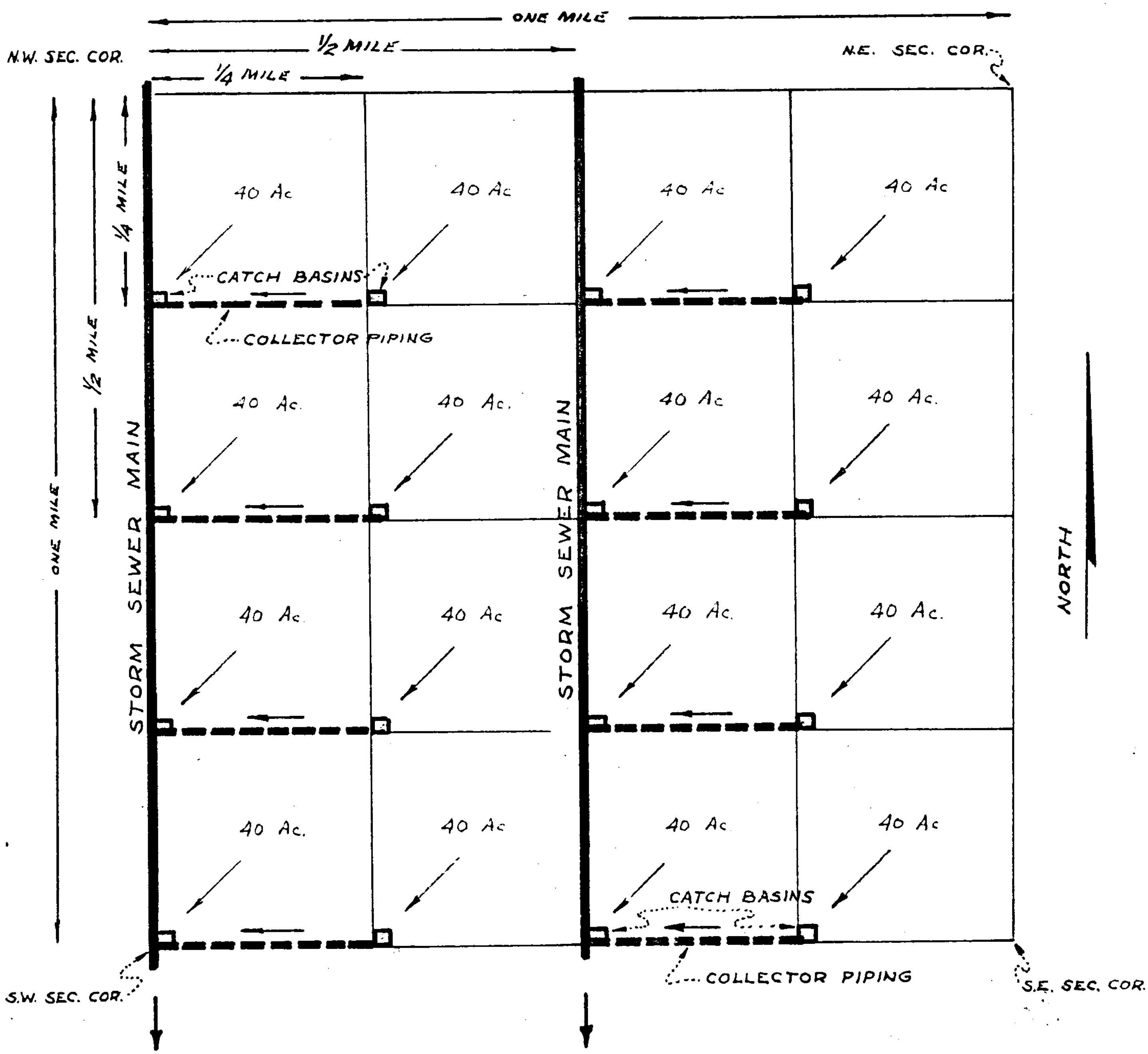


FIG. 12

STORM WATER RUNOFF COLLECTION PLAN

EAST - WEST STORM SEWER MAINS

1. STREET PAVEMENT TO CARRY RUNOFF TO THE LOW POINT OF EACH 40 ACRE DRAINAGE AREA.
2. RUNOFF TO ENTER THE COLLECTOR STORM DRAIN PIPING AT THIS LOW POINT.

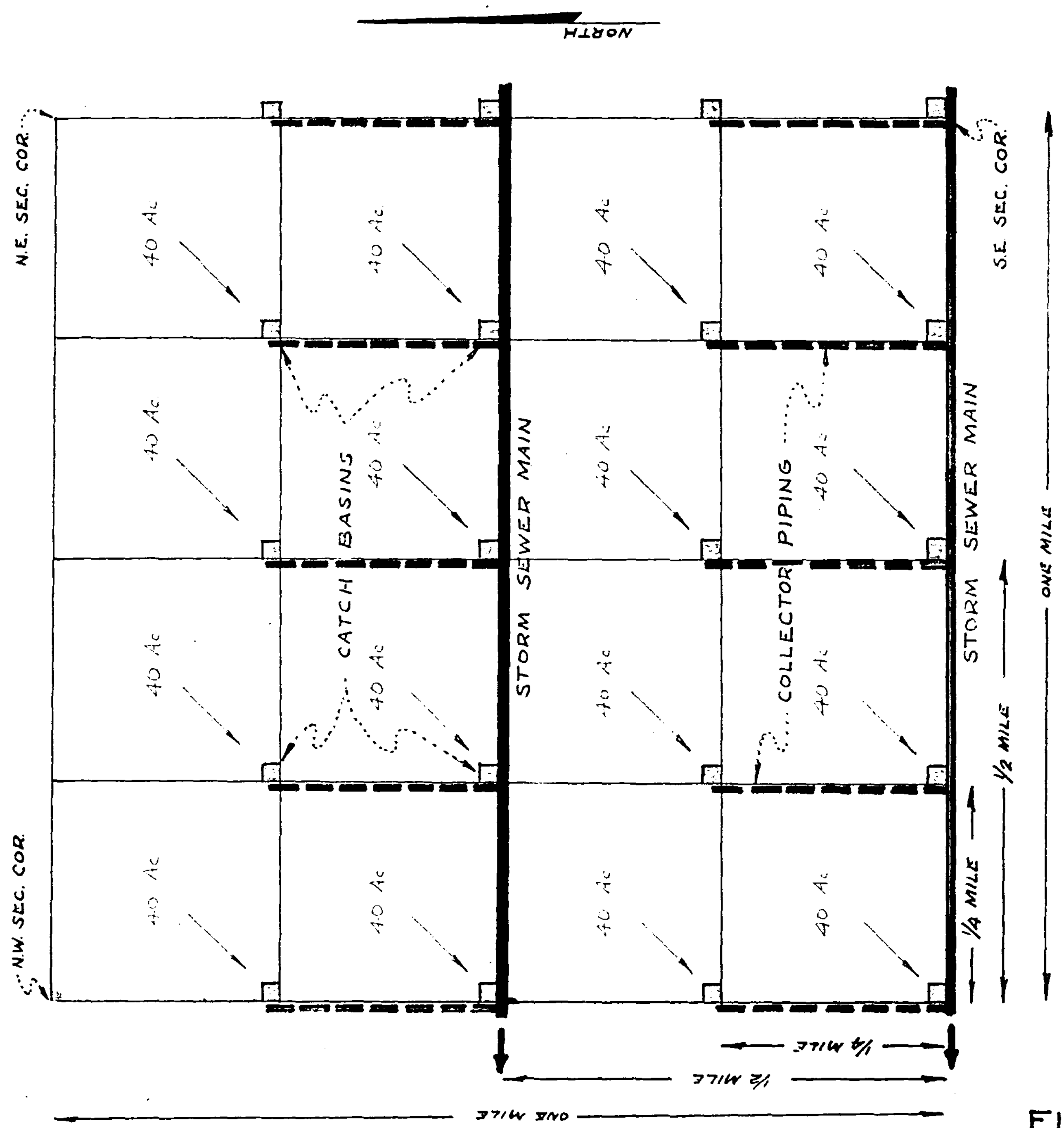


FIG. 13

Using this formula, the runoff rates to be expected in the Mesa area from a "one year design storm" were computed.

C. TIME OF CONCENTRATION

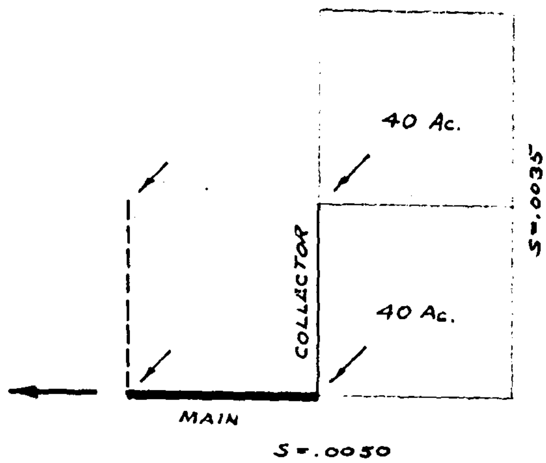
The method for determining the time of concentration used in the runoff computations is shown in Figure 14. The slope of the land affects the velocity of flow in street gutters and pipe lines. Therefore the time of concentration is affected by the slope of the individual drainage area.

TIME OF CONCENTRATION

LINE "A" THRU "F"

T.C. = 22 STREET FLOW
5½ PIPE VELOCITY
5½ LINE STORAGE

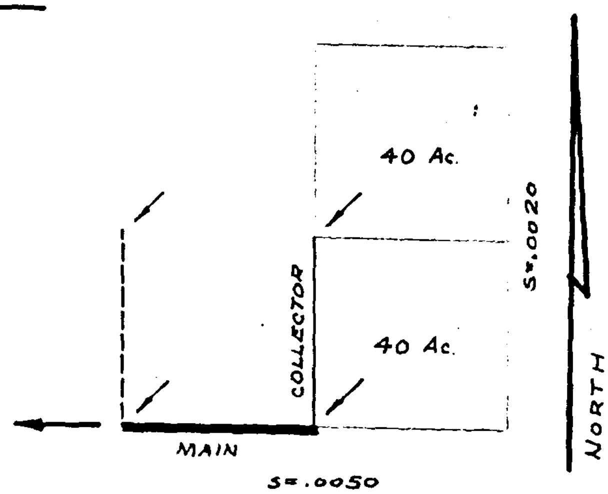
33 MINUTES



LINE "G" THRU "J"

T.C. = 25 STREET FLOW
6 PIPE VELOCITY
6 LINE STORAGE

37 MINUTES



LINE "K" THRU "M"

T.C. = 27 STREET FLOW
6½ PIPE VELOCITY
6½ LINE STORAGE

40 MINUTES

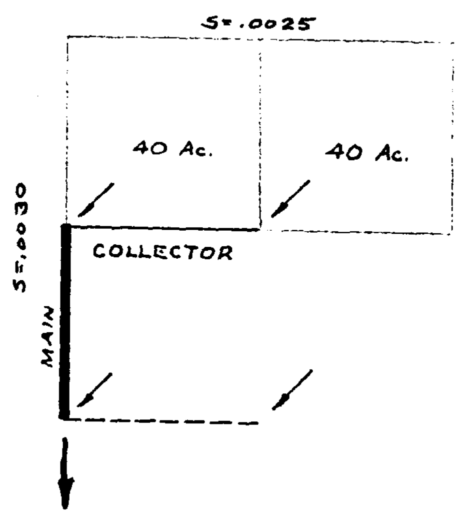


FIG. 14

RUNOFF COMPUTATIONS

ONE YEAR RAINFALL INTENSITY AND DURATION

McKELLIPS RD. LOCATION	DRAINAGE AREA ACRES: AREA A	TOTAL AREA A	IMPER. AREA A_i	TOTAL IMPER. AREA A_i	CONCENTRATION TIME	t_c		INTENSITY: I	STORM AREA	AREA COEFF.	I_A	RUNOFF $A_i = 25\%$ TOT. AREA: TOTAL FLOW CFS	DESIGN FLOW AND REMARKS
LINE "A", 0	80	80	20	20		33		.78	160	.975	.76	14	11 CFS
1		160	40	60		37		.72	160	.975	.70	38	30
2		240	20	80		41		.68	360	.96	.65	47	37^{5}
3		320		100		45		.63	640	.94	.59	53	42
4		400		120		49		.60	1000	.93	.56	60^{5}	48^{5}
5		480		140		53		.57	1440	.92	.52	65^{5}	52^{5}
6		560		160		57		.54	1960	.91	.49	70^{5}	56^{5}
7		640		180		1-1		.52	2560	.90	.47	76	61
8		720		200		1-5		.49	3240	.89	.435	78^{5}	63
9		800		220		1-9		.47	4000	.88	.41	81	65
10		880		240		1-13		.46	4840	.87	.40	86^{5}	69
A, 11	80	960	20	260		1-17		.44	5760	.86	.38	89	71

DESIGN FLOW BASED UPON IMPERVIOUS AREA EQUAL TO 20% OF TOTAL AREA.

RUNOFF COMPUTATIONS

ONE YEAR RAINFALL INTENSITY AND DURATION

20 TH STREET LOCATION	DRAINAGE AREA ACRES: AREA A	TOTAL AREA A	IMPER. AREA A_i	TOTAL IMPER. AREA A_i	CONCENTRATION TIME	t_c		INTENSITY: I	STORM AREA	AREA COEFF.	I_A	RUNOFF A_i=25% TOTAL AREA: TOTAL FLOW CFS	DESIGN FLOW AND REMARKS
LINE "B" 0													
1	80	80	20	20		33		.78	160	.975	.76	14	11 CFS
2		160		40		37		.72	160	.975	.70	25	20
3		240		60		41		.68	360	.96	.65	35	28
4		320		80		45		.63	640	.94	.59	42	33^{5}
5		400		100		49		.60	1000	.93	.56	50	40
6		480		120		53		.57	1440	.92	.52	56	45
7		560		140		57		.54	1960	.91	.49	61^{5}	49
8		640		160		1-1		.52	2560	.90	.47	68	54^{5}
9		720		180		1-9		.49	3240	.89	.435	70^{5}	56^{5}
10		800		200		1-9		.47	4000	.88	.41	74	59
B - 11	80	880	20	220		1-13		.46	4840	.87	.40	79	63

DESIGN FLOW BASED UPON IMPERVIOUS AREA EQUAL TO 20 % OF TOTAL AREA.

RUNOFF COMPUTATIONS

ONE YEAR RAINFALL INTENSITY AND DURATION

BROWN RD. LOCATION	DRAINAGE AREA ACRES: AREA A	TOTAL AREA A	IMPER. AREA A_i	TOTAL IMPER. AREA A_i	CONCENTRATION TIME	t_c		INTENSITY: I	STORM AREA	AREA COEFF.	I_A	RUNOFF A_i=25% TOTAL AREA: TOTAL FLOW CFS	DESIGN FLOW AND REMARKS
LINE "C" 0													
1													
2	80	80	20	20		33		.78	160	.975	.76	14	11 CFS
3		160		40		37		.72	160	.975	.70	25	20
4		240		60		41		.68	360	.96	.65	35	28
5		320		80		45		.63	640	.94	.59	42^{5}	34
6		400		100		49		.60	1000	.93	.56	50^{5}	40^{5}
7		480		120		53		.57	1440	.92	.52	56	45
8		560		140		57		.54	1960	.91	.49	61^{5}	49
9		640		160		1-1		.52	2560	.90	.47	67	53^{5}
10		720		180		1-5		.49	3240	.89	.435	70^{5}	56^{5}
C - 11	80	800	20	200		1-9		.47	4000	.88	.41	74	59

DESIGN FLOW BASED UPON IMPERVIOUS AREA EQUAL TO 20% OF TOTAL AREA.

RUNOFF COMPUTATIONS

SHEET 4 OF 21 — ONE YEAR RAINFALL INTENSITY AND DURATION

8TH STREET	DRAINAGE AREA ACRES				CONCENTRATION TIME			INTENSITY				RUNOFF A_i=25% TOTAL AREA	
LOCATION	AREA A	TOTAL AREA A	IMPER. AREA A_i	TOTAL IMPER. AREA A_i		t_c		I	STORM AREA	AREA COEFF.	I_A	TOTAL FLOW CFS	DESIGN FLOW AND REMARKS
LINE "D" 0													
1													
2	80	80	20	20		33		.78	160	.975	.76	14	11 CFS
3		160		40		37		.72	160	.975	.70	25	20
4		240		60		41		.68	360	.96	.65	35	28
5		320		80		45		.63	640	.94	.59	42^{5}	34
6		400		100		49		.60	1000	.93	.56	50^{5}	40^{5}
7		480		120		53		.57	1440	.92	.52	56	45
8		560		140		57		.54	1960	.91	.49	61^{5}	49
9		640		160		1-1		.52	2560	.90	.47	67	53^{5}
10		720		180		1-5		.49	3240	.89	.435	70^{5}	56^{5}
D - 11	80	800	20	200		1-9		.47	4000	.88	.41	74	59

DESIGN FLOW BASED UPON IMPERVIOUS AREA EQUAL TO 20% OF TOTAL AREA.

RUNOFF COMPUTATIONS

ONE YEAR RAINFALL INTENSITY AND DURATION

4 TH STREET	DRAINAGE AREA ACRES				CONCENTRATION TIME			INTENSITY				RUNOFF A_i=25% TOTAL AREA	
LOCATION	AREA A	TOTAL AREA A	IMPER. AREA A_i	TOTAL IMPER. AREA A_i		t_c		I	STORM AREA	AREA COEFF.	I_A	TOTAL FLOW CFS	DESIGN FLOW AND REMARKS
LINE "E" 0													
1													
2	80	80	20	20		33		.78	160	.975	.76	14	11 CFS
3		160		40		37		.72	160	.975	.70	25	20
4		240		60		41		.68	360	.96	.65	35	28
5		320		80		45		.63	640	.94	.59	42^{5}	34
6		400		100		49		.60	1000	.93	.56	50^{5}	40^{5}
7		480		120		53		.57	1440	.92	.52	56	45
8		560		140		57		.54	1960	.91	.49	61	49
9		640		160		1-1		.52	2560	.90	.47	67	53^{5}
10		720		180		1-5		.49	3240	.89	.435	70^{5}	56
E-11	80	800	20	200		1-9		.47	4000	.88	.41	74	59

DESIGN FLOW BASED UPON IMPERVIOUS AREA EQUAL TO 20% OF TOTAL AREA.

RUNOFF COMPUTATIONS

ONE YEAR RAINFALL INTENSITY AND DURATION

MAIN STREET LOCATION	DRAINAGE AREA ACRES: AREA A	TOTAL AREA A	IMPER. AREA A_i	TOTAL IMPER. AREA A_i	CONCENTRATION TIME	t_c		INTENSITY: I	STORM AREA	AREA COEFF.	I_A	RUNOFF A_i=25% TOTAL AREA: TOTAL FLOW CFS	DESIGN FLOW AND REMARKS
LINE "F" 0													
1													
2	80	80	20	20		33		.78	160	.975	.76	14	11 CFS
3		160		40		37		.72	160	.975	.70	25	20
4		240		60		41		.68	360	.96	.65	35	28
5		320		80		45		.63	640	.94	.59	42^{5}	34
6		400		100		49		.60	1000	.93	.56	50^{5}	40^{5}
7		480		120		53		.57	1440	.92	.52	56	45
8		560		140		57		.54	1960	.91	.49	61^{5}	49
9		640		160		1-1		.52	2560	.90	.47	67	53^{5}
10		720		180		1-5		.49	3240	.89	.435	70^{5}	56^{5}
F-11	80	800	20	200		1-9		.47	4000	.88	.41	74	59

DESIGN FLOW BASED UPON IMPERVIOUS AREA EQUAL TO 20% OF TOTAL AREA.

RUNOFF COMPUTATIONS

ONE YEAR RAINFALL INTENSITY AND DURATION

4TH AVENUE LOCATION	DRAINAGE AREA ACRES: AREA A	TOTAL AREA A	IMPER. AREA A_i	TOTAL IMPER. AREA A_i	CONCENTRATION TIME	t_c		INTENSITY: I	STORM AREA	AREA COEFF.	I_A	RUNOFF A_i=25% TOTAL AREA: TOTAL FLOW CFS	DESIGN FLOW AND REMARKS
LINE "G" 0													
1													
2	80	80	20	20		37		.72	160	.975	.70	13	10^{5} CFS
3		160		40		41		.68	160	.975	.66	24	19
4		240		60		45		.63	360	.96	.60	32^{5}	26
5		320		80		49		.60	640	.94	.56	40	32
6		400		100		53		.57	1000	.93	.53	47^{5}	38
7		480		120		57		.54	1440	.92	.50	54	43
8		560		140		1-1		.52	1960	.91	.47	59	47
9		640		160		1-5		.49	2560	.90	.44	63^{5}	51
10		720		180		1-9		.47	3240	.89	.42	68	54^{5}
G - 11	80	800	20	200		1-13		.46	4000	.88	.40	72	57^{5}

DESIGN FLOW BASED UPON IMPERVIOUS AREA EQUAL TO 20% OF TOTAL AREA.

RUNOFF COMPUTATIONS

SHEET 8 OF 21   ONE YEAR RAINFALL INTENSITY AND DURATION

8 TH AVENUE	DRAINAGE AREA ACRES				CONCENTRATION TIME			INTENSITY				RUNOFF $A_i = 25\%$ TOTAL AREA	
LOCATION	AREA A	TOTAL AREA A	IMPER. AREA A_i	TOTAL IMPER. AREA A_i		t_c		I	STORM AREA	AREA COEFF.	I_A	TOTAL FLOW CFS	DESIGN FLOW AND REMARKS
LINE "H" - 0													
1													
2	80	80	20	20		37		.72	160	.975	.70	13	$10^{\underline{5}}$ CFS
3		160		40		41		.68	160	.975	.66	24	19
4		240		60		45		.63	360	.96	.60	$32^{\underline{5}}$	26
5		320		80		49		.60	640	.94	.56	40	32
6		400		100		53		.57	1000	.93	.53	$47^{\underline{5}}$	38
7		480		120		57		.54	1440	.92	.50	54	43
8		560		140		1-1		.52	1960	.91	.47	59	47
9		640		160		1-5		.49	2560	.90	.44	$63^{\underline{5}}$	51
10		720		180		1-9		.47	3240	.89	.42	68	$54^{\underline{5}}$
H - 11	80	800	20	200		1-13		.46	4000	.88	.40	72	$57^{\underline{5}}$

DESIGN FLOW BASED UPON IMPERVIOUS AREA EQUAL TO 20% OF TOTAL AREA.

RUNOFF COMPUTATIONS

SHEET 9 OF 21 ONE YEAR RAINFALL INTENSITY AND DURATION

SOUTHERN AVE. LOCATION	DRAINAGE AREA ACRES AREA A	TOTAL AREA A	IMPER. AREA A_i	TOTAL IMPER. AREA A_i	CONCENTRATION TIME	t_c		INTENSITY I	STORM AREA	AREA COEFF.	I_A	RUNOFF A_i=25% TOTAL AREA TOTAL FLOW CFS	DESIGN FLOW AND REMARKS
LINE "J" - 0	—	—	—	—		—	—	—	—	—	—	—	
1	—	—	—	—								—	
2	80	80	20	20		37		.72	160	.975	.70	13	10^{5} CFS
3		160		40		41		.68	160	.975	.66	24	19
4		240		60		45		.63	360	.96	.60	32^{5}	26
5		320		80		49		.60	640	.94	.56	40	32
6		400		100		53		.57	1000	.93	.53	47	38
7		480		120		57		.54	1440	.92	.50	54	43
8		560		140		1-1		.52	1960	.91	.47	59	47
9		640		160		1-5		.49	2560	.90	.44	63^{5}	51
10		720		180		1-9		.47	3240	.89	.42	68	54^{5}
J - 11	80	800	20	200		1-13		.46	4000	.88	.40	72	57^{5}

DESIGN FLOW BASED UPON IMPERVIOUS AREA EQUAL TO 20% OF TOTAL AREA.

RUNOFF COMPUTATIONS

ONE YEAR RAINFALL INTENSITY AND DURATION

GILBERT RD. LOCATION	DRAINAGE AREA ACRES AREA A	TOTAL AREA A	IMPER. AREA A_i	TOTAL IMPER. AREA A_i	CONCENTRATION TIME t_c	INTENSITY I	STORM AREA	AREA COEFF.	I_A	RUNOFF A_i=25% TOTAL AREA TOTAL FLOW CFS	DESIGN FLOW AND REMARKS
LINE "K" - 0	80	80	20	20	40	.68	160	.975	.66	12	10 CFS
1		160		40	44	.64	160	.975	.625	22^{5}	18
2		240		60	48	.61	360	.96	.585	31^{5}	25
3		320		80	52	.58	640	.94	.545	39	31
4		400		100	56	.55	1000	.93	.51	46	37
5		480		120	60	.52	1440	.92	.48	52	41^{5}
6		560		140	1-4	.50	1960	.91	.455	57	45^{5}
7		640		160	1-8	.48	2560	.90	.43	62	49^{5}
8		720		180	1-12	.47	3240	.89	.42	68	54^{5}
9		800		200	1-16	.45	4000	.88	.395	71	57
10		880		220	1-20	.44	4840	.86	.38	75	60
11		960		240	1-24	.43	5760	.85	.365	79	63
12		1040		260	1-28	.42	6780	.84	.35	82	65^{5}
13		1120		280	1-32	.40	7850	.83	.33	83	66^{5}
14		1200		300	1-36	.39	9000	.82	.32	86^{5}	69
15		1280		320	1-40	.38	10,250	.81	.31	89^{5}	71
16		1360		340	1-44	.37	11,600	.80	.295	90^{5}	72^{5}
K- 17	80	1440	20	360	1-48	.35	13,000	.79	.28	90^{5}	72^{5}

DESIGN FLOW BASED UPON IMPERVIOUS AREA EQUAL TO 20% OF TOTAL AREA.

Sheet 11 of 21

RUNOFF COMPUTATIONS

ONE Year Rainfall Intensity and Duration

HARRIS DR. LOCATION	Drainage Area Acres: Area A	Total Area A	Imper. Area A_i	Total Imper. Area A_i	Concentration Time	t_c		Intensity: I	Storm Area	Area Coeff.	I_A	Runoff A_i=25% Total Area: Total Flow CFS	Design Flow and Remarks
Line "L" - 0	80	80	20	20		40		.68	160	.975	.66	12	10 CFS
1		160		40		44		.64	160	.975	.625	22^{5}	18
2		240		60		48		.61	360	.96	.585	31^{5}	25
3		320		80		52		.58	640	.94	.545	39	31
4		400		100		56		.55	1000	.93	.51	46	37
5		480		120		60		.52	1440	.92	.48	52	41^{5}
6		560		140		1-4		.50	1960	.91	.455	57	45^{5}
7		640		160		1-8		.48	2560	.90	.43	62	49^{5}
8		720		180		1-12		.47	3240	.89	.42	68	54^{5}
9		800		200		1-16		.45	4000	.88	.395	71	57
10		880		220		1-20		.44	4840	.86	.38	75	60
11		960		240		1-24		.43	5760	.85	.365	79	63
12		1040		260		1-28		.42	6780	.84	.35	82	65^{5}
13		1120		280		1-32		.40	7850	.83	.33	83	66^{5}
14		1200		300		1-36		.39	9000	.82	.32	86^{5}	69
15		1280		320		1-40		.38	10,250	.81	.31	89^{5}	71
16		1360		340		1-44		.37	11,600	.80	.295	90^{5}	72^{5}
L- 17	80	1440	20	360		1-48		.35	13,000	.79	.28	90^{5}	72^{5}

Design Flow based upon impervious area equal to 20% of total area.

RUNOFF COMPUTATIONS

SHEET 12 OF 21 ONE YEAR RAINFALL INTENSITY AND DURATION

STAPLEY DR. LOCATION	DRAINAGE AREA ACRES AREA A	TOTAL AREA A	IMPER. AREA A_i	TOTAL IMPER. AREA A_i	CONCENTRATION TIME	t_c		INTENSITY I	STORM AREA	AREA COEFF.	I_A	RUNOFF A_i=25% TOTAL AREA TOTAL FLOW CFS	DESIGN FLOW AND REMARKS
LINE "M" - 0	—	—	—	—	—	—	—	—	—	—	—	—	
1	—	—	—	—	—	—	—	—	—	—	—	—	
2	80	80	20	20		40		.68	160	.975	.66	12	10 CFS
3		160		40		44		.64	160	.975	.625	22^{5}	18
4		240		60		48		.61	360	.96	.585	31^{5}	25
5		320		80		52		.58	640	.94	.545	39	31
6		400		100		56		.55	1000	.93	.51	46	37
7		480		120		60		.52	1440	.92	.48	52	41^{5}
8		560		140		1-4		.50	1960	.91	.455	57	45^{5}
9		640		160		1-8		.48	2560	.90	.43	62	49^{5}
10		720		180		1-12		.47	3240	.89	.42	68	54^{5}
11		800		200		1-16		.45	4000	.88	.395	71	57
12		880		220		1-20		.44	4840	.86	.38	75	60
13		960		240		1-24		.43	5760	.85	.365	79	63
14		1040		260		1-28		.42	6780	.84	.35	82	65^{5}
15		1120		280		1-32		.40	7850	.83	.33	83	66^{5}
16		1200		300		1-36		.39	9000	.82	.32	86^{5}	69
M - 17	80	1280	20	320		1-40		.38	10,250	.81	.31	89^{5}	71

DESIGN FLOW BASED UPON IMPERVIOUS AREA EQUAL TO 20% OF TOTAL AREA.

RUNOFF COMPUTATIONS

SHEET 13 OF 21 ONE YEAR RAINFALL INTENSITY AND DURATION

HORNE STREET LOCATION	DRAINAGE AREA ACRES: AREA A	TOTAL AREA A	IMPER. AREA A_i	TOTAL IMPER. AREA A_i	CONCENTRATION TIME	t_c		INTENSITY: I	STORM AREA	AREA COEFF.	I_A	RUNOFF A_i=25% TOTAL AREA: TOTAL FLOW CFS	DESIGN FLOW AND REMARKS
LINE "N" - 0													
1													
2													
3													
4													
5	270	270	68	68		46		.62	640	.94	.58	35^{5}	28^{5} CFS
6	80	350	20	88		50		.59	1000	.93	.55	43^{5}	35
7		430		108		54		.56	1440	.92	.515	50	40
8		510		128		58		.53	1960	.91	.48	55	44
9		590		148		1-2		.51	2560	.90	.46	61^{5}	49
10		670		168		1-6		.49	3240	.89	.435	65^{5}	52^{5}
11		750		188		1-10		.48	4000	.88	.42	71	57
12		830		208		1-14		.46	4840	.86	.395	74	59
13		910		228		1-18		.45	5760	.85	.38	78	62^{5}
14		990		248		1-22		.44	6750	.84	.37	82^{5}	66
15		1070		268		1-26		.43	7850	.83	.36	87	69^{5}
16		1150		288		1-30		.41	9000	.82	.335	87	69^{5}
N - 17	80	1230	20	308		1-34		.39	10,250	.81	.315	87^{5}	70

DESIGN FLOW BASED UPON IMPERVIOUS AREA EQUAL TO 20% OF TOTAL AREA.

RUNOFF COMPUTATIONS

SHEET 14 OF 21 ONE YEAR RAINFALL INTENSITY AND DURATION

MESA DRIVE LOCATION	DRAINAGE AREA ACRES: AREA A	TOTAL AREA A	IMPER. AREA A_i	TOTAL IMPER. AREA A_i	CONCENTRATION TIME	t_c		INTENSITY: I	STORM AREA	AREA COEFF.	I_A	RUNOFF A_i=25% TOTAL AREA: TOTAL FLOW CFS	DESIGN FLOW AND REMARKS
LINE "O" - 0													
1													
2													
3													
4													
5													
6	60	60	15	15		45		.62	160	.975	.60	8	$6^{\underline{5}}$ CFS
7	20	80	5	20		49		.59	160	.975	.575	$10^{\underline{5}}$	$8^{\underline{5}}$
8	80	160	15	35		53		.56	360	.96	.54	17	$13^{\underline{5}}$
9		240	20	55		57		.53	640	.94	.50	25	20
10		320	20	75		1-1		.51	1000	.93	.475	32	$25^{\underline{5}}$
11		400	10	85		1-5		.49	1440	.92	.45	$34^{\underline{5}}$	27
12		480	15	100		1-9		.48	1960	.91	.435	39	31
13		560	15	115		1-13		.46	2560	.90	.415	43	34
14		640	60	175		1-17		.45	3240	.89	.40	63	50
15		720	20	195		1-21		.44	4000	.88	.39	$68^{\underline{5}}$	55
16		800	20	215		1-25		.43	4840	.86	.37	$71^{\underline{5}}$	57
O - 17	80	880	20	235		1-29		.41	5760	.85	.35	74	59

DESIGN FLOW BASED UPON IMPERVIOUS AREA EQUAL TO 20% OF TOTAL AREA.

RUNOFF COMPUTATIONS

SHEET 15 OF 21 — ONE YEAR RAINFALL INTENSITY AND DURATION

16 TH AVENUE LOCATION	DRAINAGE AREA ACRES: AREA A	TOTAL AREA A	IMPER. AREA A_i	TOTAL IMPER. AREA A_i	CONCENTRATION TIME	t_c		INTENSITY: I	STORM AREA	AREA COEFF.	I_A	RUNOFF A_i=25% TOTAL AREA — TOTAL FLOW CFS	DESIGN FLOW BASED UPON IMPERVIOUS AREA EQUAL TO 20% OF TOTAL AREA. DESIGN FLOW AND REMARKS
LINE "P" - O-2													
3	80	80	20	20		37		.72	160	.975	.70	12^{5}	10 CFS
4		160		40		41		.68	160	.975	.66	23^{5}	19
5		240		60		45		.63	360	.96	.60	32^{5}	26
6		320		80		49		.60	640	.94	.56	40	32
7		400		100		53		.57	1000	.93	.53	48	38^{5}
8		480		120		57		.54	1440	.92	.50	54	43
9		560		140		1-1		.52	1960	.91	.47	59	47
10		640		160		1-5		.49	2560	.90	.44	63^{5}	51
11		720		180		1-9		.47	3240	.89	.42	68	54
12		800		200		1-13		.46	4000	.88	.40	72	57^{5}
13		880		220		1-17		.45	4840	.87	.39	77	61^{5}
14		960		240		1-21		.44	5760	.85	.375	81	65
15		1040		260		1-25		.42	6780	.84	.35	82	65^{5}
16		1120		280		1-29		.40	7850	.83	.33	83	66^{5}
17		1200		300		1-33		.39	9000	.82	.32	86	69
18		1280		320		1-37		.38	10,250	.81	.30	86^{5}	69
19		1360		340		1-41		.37	11,600	.80	.29	89	71
20		1440		360		1-45		.36	13,000	.79	.28	90^{5}	72^{5}
21	80	1520	20	380		1-49		.35	14,400	.78	.27	92^{5}	74

RUNOFF COMPUTATIONS

SHEET 16 OF 21 — ONE YEAR RAINFALL INTENSITY AND DURATION

BASELINE RD. LOCATION	DRAINAGE AREA ACRES: AREA A	TOTAL AREA A	IMPER. AREA A_i	TOTAL IMPER. AREA A_i	CONCENTRATION TIME t_c		INTENSITY: I	STORM AREA	AREA COEFF.	I_A	RUNOFF A_i=25% TOTAL AREA — TOTAL FLOW CFS	DESIGN FLOW BASED UPON IMPERVIOUS AREA EQUAL TO 20% OF TOTAL AREA. DESIGN FLOW AND REMARKS
LINE "Q" 0-1												
2	80	80	20	20	37		.72	160	.975	.70	$12^{\underline{5}}$	10 CFS
3		160		40	41		.68	160	.975	.66	$23^{\underline{5}}$	19
4		240		60	45		.63	360	.96	.60	$32^{\underline{5}}$	26
5		320		80	49		.60	640	.94	.56	40	32
6		400		100	53		.57	1000	.93	.53	48	$38^{\underline{5}}$
7		480		120	57		.54	1440	.92	.50	54	43
8		560		140	61		.52	1960	.91	.47	59	47
9		640		160	1-5		.49	2560	.90	.44	$63^{\underline{5}}$	51
10		720		180	1-9		.47	3240	.89	.42	68	54
11		800		200	1-13		.46	4000	.88	.40	72	$57^{\underline{5}}$
12		880		220	1-17		.45	4840	.87	.39	77	$61^{\underline{5}}$
13		960		240	1-21		.44	5760	.85	.37	81	65
14		1040		260	1-25		.42	6780	.84	.35	82	$65^{\underline{5}}$
15		1120		280	1-29		.40	7850	.83	.33	83	$66^{\underline{5}}$
16		1200		300	1-33		.39	9000	.82	.32	86	69
17		1280		320	1-37		.38	10250	.81	.30	$86^{\underline{5}}$	69
18		1360		340	1-41		.37	11,600	.80	.29	89	71
2		1440		360	1-45		.36	13,000	.79	.28	$90^{\underline{5}}$	72
20		1520		380	1-49		.35	14,400	.78	.27	$92^{\underline{5}}$	74
21	80	1600	20	400	1-53		.34	16,000	.77	.26	94	75

RUNOFF COMPUTATIONS

SHEET 17 OF 21 ONE YEAR RAINFALL INTENSITY AND DURATION

CENTER STREET LOCATION	DRAINAGE AREA ACRES: AREA A	TOTAL AREA A	IMPER. AREA A_i	TOTAL IMPER. AREA A_i	CONCENTRATION TIME	t_c		INTENSITY: I	STORM AREA	AREA COEFF.	I_A	RUNOFF A_i=25% TOTAL AREA: TOTAL FLOW CFS	DESIGN FLOW AND REMARKS
LINE "R" - 6	80	80	20	20		40		.68	160	.975	.66	12	9^5 CFS
7	80	160	20	40		44		.64	160	.975	.625	22^5	18
8	50	210	12	52		48		.61	360	.96	.585	27^5	22
9	80	290	10	62		52		.58	640	.94	.545	30^5	24^5
10													
11	160	450	20	82		1-2		.51	1440	.92	.47	35	28
12													
13	160	610	20	102		1-12		.47	2560	.90	.42	38^5	31^5
14	80	690		122		1-16		.45	3240	.89	.40	44	35
15		770		142		1-20		.44	4000	.88	.385	49	39
16		850		162		1-24		.43	4840	.86	.37	55^5	44^5
17		930		182		1-28		.42	5760	.85	.355	58	46^5
18		1010		202		1-32		.40	6780	.84	.335	61	49
19		1090		222		1-36		.39	7850	.83	.32	64	51
20		1170		242		1-40		.38	9000	.82	.31	67^5	54
R - 21	80	1250	20	262		1-44		.37	10,250	.81	.30	71	57

DESIGN FLOW BASED UPON IMPERVIOUS AREA EQUAL TO 20% OF TOTAL AREA.

RUNOFF COMPUTATIONS

SHEET 18 OF 21 — ONE YEAR RAINFALL INTENSITY AND DURATION

COUNTRY CLUB DR. LOCATION	DRAINAGE AREA ACRES: AREA A	TOTAL AREA A	IMPER. AREA A_i	TOTAL IMPER. AREA A_i	CONCENTRATION TIME t_c	INTENSITY: I	STORM AREA	AREA COEFF.	I_A	RUNOFF A_i=25% TOTAL AREA: TOTAL FLOW CFS	DESIGN FLOW AND REMARKS
LINE "S" – 6	80	80	20	20	40	.68	160	.975	.66	12	9^{5} CFS
7		160		40	44	.64	160	.975	.62	22	17^{5}
8		240		60	48	.61	360	.96	.585	31^{5}	25
9	80	320	20	80	52	.58	640	.94	.545	39	31
10											
11	100	420	20	100	60	.52	1440	.92	.48	43	34^{5}
S – 12	64	480	10	110	1-4	.50	1960	.91	.455	45	36
T – 12	40	520	10	120	1-12	.47	2560	.90	.43	46^{5}	37
LINE "S" – 13											
14	80	80	20	20	40	.68	160	.975	.66	12	9^{5}
15		160		40	44	.64	160	.975	.62	22	17^{5}
16		240		60	48	.61	360	.96	.585	31	25
17		320		80	52	.58	640	.94	.545	39	31
18		400		100	56	.55	1000	.93	.51	46	37
19		480		120	60	.52	1440	.92	.48	52	41^{5}
20		560		140	1-4	.50	1960	.91	.455	57^{5}	45^{5}
21	80	640	20	160	1-8	.48	2560	.90	.43	62	50

DESIGN FLOW BASED UPON IMPERVIOUS AREA EQUAL TO 20% OF TOTAL AREA.

RUNOFF COMPUTATIONS

SHEET 19 OF 21 — ONE YEAR RAINFALL INTENSITY AND DURATION

EXTENSION RD. LOCATION	DRAINAGE AREA ACRES: AREA A	TOTAL AREA A	IMPER. AREA A_i	TOTAL IMPER. AREA A_i	CONCENTRATION TIME t_c	INTENSITY: I	STORM AREA	AREA COEFF.	I_A	RUNOFF $A_i = 25\%$ TOTAL AREA: TOTAL FLOW CFS	DESIGN FLOW AND REMARKS
LINE "T" - 6	40	40	10	10	40	.68	160	.975	.66	6	5 CFS
7	80	120	20	30	44	.64	160	.975	.64	17	$13^{\underline{5}}$
8		200		50	48	.61	360	.96	.585	26	21
9		280		70	52	.58	640	.94	.545	$34^{\underline{5}}$	27
10		360		90	56	.55	1000	.93	.51	41	33
11	80	440	20	110	60	.52	1440	.92	.48	$47^{\underline{5}}$	38
12 *	520	960	120	230	1-12	.47	1960	.91	.43	89	71
13	80	1040	20	250	1-16	.45	2560	.90	.405	91	73
14		1120		270	1-20	.44	3240	.89	.39	$94^{\underline{5}}$	$75^{\underline{5}}$
15		1200		290	1-24	.43	4000	.88	.38	99	79
16		1280		310	1-28	.42	4840	.86	.36	100	80
17		1360		330	1-32	.40	5760	.85	.34	101	81
18		1440		350	1-36	.39	6780	.84	.33	104	83
19		1520		370	1-40	.38	7850	.83	.315	105	84
20		1600		390	1-44	.37	9000	.82	.30	105	84
21	80	1680	20	410	1-48	.36	10,250	.81	.29	107	$85^{\underline{5}}$

* ADDN. OF RUNOFF FROM LINE "S"

DESIGN FLOW BASED UPON IMPERVIOUS AREA EQUAL TO 20% OF TOTAL AREA.

RUNOFF COMPUTATIONS

ONE YEAR RAINFALL INTENSITY AND DURATION

INTERCEPTOR STORM DRAIN LOCATION	DRAINAGE AREA ACRES: AREA A	TOTAL AREA A	IMPER. AREA A_i	TOTAL IMPER. AREA A_i	CONCENTRATION TIME t_c	INTENSITY: I	STORM AREA	AREA COEFF.	I_A	RUNOFF A_i=25% TOTAL AREA: TOTAL FLOW CFS 25%	DESIGN FLOW AND REMARKS 20%	15%	
POINT "A"	960	960	260	260	1-17	.44	5760	.86	.38	89	71	53	CFS
B	880	1840	220	480	1-27	.43			.37	160	128	96	
C	800	2640	200	680	1-37	.38			.33	202	162	121	
D	800	3440		880	1-47	.35			.30	238	190	143	
E	800	4240		1080	1-57	.32			.275	267	214	160	
F	800	5040		1280	2-7	.30	5760	.86	.26	300	240	180	
G	800	5840		1480	2-17	.28	7850	.84	.235	313	250	188	
H	800	6640		1680	2-27	.27	10,250	.82	.22	332	265	200	
J	800	7440	200	1880	2-37	.265	13,000	.795	.21	355	284	213	
K	1440	8880	360	2240	2-47	.26			.205	414	330	248	
L	1440	10,320	360	2600	2-57	.25			.20	468	375	280	
M	1280	11,600	320	2920	3-7	.24			.19	500	400	300	
N	1230	12,830	308	3228	3-17	.23	13,000	.795	.18	520	415	312	
MESA DR. & SOUTHERN O	880	13,710	235	3465	3-27	.22	16,000	.77	.17	530	424	318	
P	1520	15,230	380	3845	3-37	.21	16,000	.77	.16	552	442	332	
MESA DR. & BASELINE Q	1600	16,830	400	4245	3-47	.20	19,300	.75	.15	570	455	342	
R	1250	18,080	262	4507	3-57	.19	23,000	.73	.14	565	452	340	
S	640	18,720	160	4667	4-7	.18	27,000	.715	.13	548	437	328	
EXTENSION RD. & BASELINE T	1680	20,400	410	5077	4-17	.17	31,300	.69	.117	535	428	320	

RUNOFF COMPUTATIONS

ONE YEAR RAINFALL INTENSITY AND DURATION

INTERCEPTOR STORM DRAIN LOCATION	DRAINAGE AREA ACRES: AREA A	TOTAL AREA A	IMPER. AREA A_i	TOTAL IMPER. AREA A_i	CONCENTRATION TIME t_c	INTENSITY: I	STORM AREA	AREA COEFF.	I_A	RUNOFF A_i=25% TOTAL AREA: TOTAL FLOW CFS 25%	DESIGN FLOW AND REMARKS 20%	15%	
POINT "A"	960	960	260	260	1-17	.44	5760	.86	0.38	89	71	53	CFS
B	880	1840	220	480	1-27	.43			0.37	160	128	96	
C	800	2640	200	680	1-37	.38			0.33	202	162	121	
D	800	3440		880	1-47	.35			0.30	238	190	143	
E	800	4240		1080	1-57	.32			0.275	267	214	160	
F	800	5040		1280	2-7	.30	5760	.86	0.26	300	240	180	
G	800	5840		1480	2-17	.28	7850	.84	0.235	313	250	188	
H	800	6640		1680	2-27	.27	10,250	.82	0.22	332	265	200	
J	800	7440	200	1880	2-37	.265	13,000	.795	0.21	355	284	213	
K	1440	8880	360	2240	2-47	.26			0.205	414	330	248	
L	1440	10,320	360	2600	2-57	.25			0.20	468	375	280	
M	1280	11,600	320	2920	3-07	.24			0.19	500	400	300	
N	1230	12,830	308	3228	3-17	.23	13,000	.795	0.18	520	415	312	
MESA DR. & SOUTHERN O	880	13,710	235	3465	3-27	.22	16,000	.77	0.17	530	424	318	
P													
Q													
R	1250	14960	262	3727	3-57	.19	23,000	.73	0.14	470	376	282	
S	640	15,600	160	4667	4-07	.18	27,000	.715	0.13	455	364	273	
EXTENSION RD. & BASELINE T	1680	17280	410	5077	4-17	.17	31,300	.69	0.117	450	360	270	

NOTE: RUNOFF FROM LINES "P" AND "Q" NOT INCLUDED IS THESE COMPUTATIONS.

RUNOFF COMPUTATIONS

SHEET ____ OF ____

ONE YEAR RAINFALL INTENSITY AND DURATION

INTERCEPTOR STORM DRAIN LINE "K" thru "T", EXCEPT LINES "P" & "Q"

LOCATION	DRAINAGE AREA ACRES				CONCENTRATION TIME	INTENSITY				RUNOFF $A_i = 25\%$ TOTAL AREA	DESIGN FLOW AND REMARKS
	AREA A	TOTAL AREA A	IMPER. AREA A_i	TOTAL IMPER. AREA A_i	t_c	I	STORM AREA	AREA COEFF.	I_A	TOTAL FLOW CFS	
K	1440	1440	360	360	1-48	.35	13,000	.79	.28	91 CFS	73 CFS
L	1440	2880	360	720	1-58	.32			.25	162	130
M	1280	4160	320	1040	2-08	.30			.24	224	179
N	1230	5390	308	1348	2-18	.28			.22	265	211
O	880	6270	235	1583	2-28	.27			.215	306	245
P	—	6270	—	1583	2-38	.265			.21	298	238
Q	—	6270	—	1583	2-48	.26			.205	291	233
R	1250	7520	262	1845	2-58	.25	19,400	.75	.19	315	251
S	640	8160	160	2005	3-08	.24			.18	325	260
T	1680	9840	410	2415	3-18	.23			.17	370	296

DESIGN FLOW BASED UPON IMPERVIOUS AREA EQUAL TO 20% OF TOTAL AREA.

DESCRIPTION OF POSSIBLE COLLECTION SYSTEMS

Combined System

The Salt River Valley Water Users Association has proposed the combined use of their laterals and ditches, where practical, for irrigation water and storm water. This will mean the design of the Combined irrigation laterials and storm water sewers to carry both flows at the same time. Specially designed structures may be required.

Separate System

This would mean the storm drain system would be built independently. The Salt River Valley Water Users Association laterals and ditches would be tiled as they have been in the past and designed to handle irrigation flows only. As the new storm drain lines are installed we would reconnect existing storm inlets to the storm drain trunk lines.

ASSOCIATED DRAINAGE PROBLEMS

Gila Drain

Disposal of storm water runoff from the Mesa area must be to the Gila River because of the natural slope of the land. The Salt River Valley Water Users Association has the right-of-way to an old drainage channel extending from the Eastern end of the South Mountains to the Gila River. This channel could be improved to handle storm water collected in the Mesa area as well as from Tempe, Gilbert, and Chandler areas. The Maricopa County Flood Control District has indicated they may undertake the necessary improvements to this drain channel, which is called the Gila Drain.

Improvements to Western Canal

This canal, located one and one-half miles South of Baseline Road, has been mentioned with regard to the disposal of storm water run off from the Mesa area.

Improvements and modifications to the Western Canal may be required. Also, a new channel will be required to carry storm water from the Mesa area to the Western Canal.

STORM WATER COLLECTION PLANS

(A) Plates 1 and 2 show two collection plans, both of which assume the storm water must be collected and transported to the intersection of Baseline and Extension Roads. From this point the water would be handled by the Gila Drain channels.

Plate 1 shows the proposed overall storm water collection plan for Mesa and vicinity.

Plate 2 shows the initial portion of the storm water collection plan needed to provide storm water facilities for the developed areas of Mesa.

(B) Plate 3 shows the initial portion of the storm water collection plan needed to provide storm water facilities for the developed areas of Mesa. This plan assumes the storm water facilities along Extension Road and Baseline Road to be built by the Maricopa County Flood Control District.

COMPARISON OF SYSTEMS AND CONSTRUCTION COSTS

Separate System

The total cost of building two separate systems to handle irrigation and storm water is greater than the cost of one combined-use system. In favor of the separate system is the advantage of the system being designed specifically for the purpose of conducting storm water runoff. Also in some instances the separate system is more flexible not having to be guided by the location or the design requirements of the irrigation lateral with which it is to be in combined-use.

The cost of the separate system must be borne entirely by the City of Mesa. No financial aid can be expected from the Salt River Valley Water Users Association.

Combined-use System

The total cost of building the combined-use system is less than the total cost of the separate systems. The Salt River Valley Water Users Association is expected to co-operate and participate in the cost of the combined-use system. Also, The Salt River Valley Water Users Association may agree to use their forces and equipment to install cast-in-place tile at a cost considerably below the private contractor's prices. The City of Mesa would be expected to pay the balance of the cost to build the combined-use pipe lines.

One possible draw-back to the combined-use systems is the effect the water users irrigation operation may have upon the storm water design capacity.

STREET PLANNING AND RIGHT-A-WAY

Since the streets play an important part in the collection of storm water run-off the streets pattern must conform to the storm water collection plan.

Many times, special right-of-way or easement in necessary for the proper design and location of storm water drain facilities.

RECOMMENDATIONS

(A) A Combined-use system for irrigation and storm water is recommended. The combined-use system takes advantage of the lowest construction costs with the resulting lowest cost to the City of Mesa.

(B) Recommend the storm water collection plan as shown on plate 2 be built first. This drainage plan will provide storm drainage for the developed areas of Mesa.

(C) The key to the construction schedule is based upon the facilities to dispose of the storm water. Construction of the Gila Drain facility by the Maricopa County Flood Control District is not expected before 1963. Therefore construction of the interceptine storm channel, as shown on Plate 2, is recommended to co-incide with the Maricopa County Flood Control District construction schedule. During the interim until 1963 it is recommended that construction begin on the combined-used facilities as shown on Plate 2, to prevent additional tiling of irrigation laterals not designed for combined-used flows.

STREET PLANNING AND RIGHT-OF-WAY

Recommend the appropriate authorities initiate policy to insure future street drainage patterns conform to the storm water collection plan and that the proper streets are kept open. That the necessary right-of-way for future storm drain facilities be required from new sub-divisions and other developments.

RECOMMENDED DISTRIBUTION OF COSTS:

Gila Drain-- Expect the Maricopa County Flood Control District to finance this project.

Interceptor-- Expect the City of Mesa and the Salt River Valley Water Users Association to finance this phase of the work. Since this channel would benefit the City of Mesa as a whole the City's share of the cost should come from the City at large, possibly from bonds.

Combined-Use Trunk-- Salt River Valley Water Users Association will contribute toward the construction cost. Also a savings will be affected if the Salt River Water Users Association builds these pipe lines. The balance of the construction cost must be paid for by the City of Mesa. This portion of the cost may come from the adjacent sub-divider, property assessments and general obligation bonds.

Sub-division Collector-- Recommend this work be paid for by the sub-divider or benefiting property.

Separate Trunk-- The City of Mesa must assume the entire cost of this work. This cost may be proportioned to the sub-divider, property assessment and the City of Mesa bond money.


STORM WATER RUNOFF
COLLECTION PLAN
CITY OF MESA AND VICINITY
PLATE 3
PAGE 58
Salt River
Indian Reservation
NORTH
Salt River
LEGEND
DIRECTION OF FLOW
STORM SEWER
FUTURE STORM SEWERS
DRAINAGE CHANNELS
(MARICOPA FLOOD CONTROL DISTRICT)
SEWAGE TREATMENT PLANT
WELL #9
WELL #8
10 mg GROUND STORAGE
CONTROL PANEL
WELL #7
WELL #6
#10
TEMPE CANAL
TO GILA DRAIN
MESA
and
VICINITY
BROWN ROAD
TRANSMISSION ROAD
APACHE
BROADWAY
SOUTHERN AVE
BASELINE ROAD
VAL VISTA ROAD
GREENFIELD ROAD

Storm Water Runoff Collection Plan
City of Mesa and Vicinity
Plate 2
Page 57
Salt River Indian Reservation
North
Legend
100 CFS Estimate of Flow Direction of Flow
Storm Sewers
Future Storm Sewers
Sewage Treatment Plant
Well #9
Well #8
10 MG Ground Storage
Control Panel
Well #7
Intercepting Storm Sewer
Southern Ave.
59 CFS
70 CFS
71 CFS
73 CFS
O
N
M
L
K
211 CFS
179 CFS
130 CFS
73 CFS
245 CFS
P
238 CFS
Canal
Tempe
86 CFS
50 CFS
57 CFS
Intercepting Storm Sewer
T
S
R
Q
260 CFS
251 CFS
233 CFS
MESA and VICINITY
Baseline Rd.
Extension
Country Club
Center
Mesa Drive
Horne
Stapley
Harris
Gilbert
Falcon #1
New 300,000 Gal. El. Tank
Falcon Well #2
Broadway