HYDROLOGY ○ F20/D2 ○ 3 PLANS

F20/D2

3 PLANS

Bruno - Info File RRT

MEURER, SERAFINI AND MEURER, INC.

CONSULTING ENGINEERS • SURVEYORS • PLANNERS

2601 WYOMING BLVD., N.E., SUITE F • ALBUQUERQUE, NEW MEXICO 87110 • (505) 292-1936

F-20-D2

August 2, 1979

RECEIVED

AUG 03 1979

CITY ENGINEER

Mr. Richard W. Krimm
Assistant Administrator for Flood Insurance
Office of Flood Insurance
U.S. Dept. of Housing & Urban Development
Washington, D.C. 20410

RE: Academy Estates, Unit 8, Albuquerque (Bernalillo County)
New Mexico IFE (218, FLO-1)

Dear Mr. Krimm:

Pursuant to my conversation with Bill Adams of Michael Baker Jr., Consulting Engineers, on July 31, 1979, I am transmitting a print showing the rear lot corner elevation along the Bear Tributary Arroyo at the above referenced development.

I believe this information will be suitable for your evaluation of the flood plain.

Should you have any additional comments, please feel free to call me.

Very truly yours,

MEURER, SERAFINI AND MEURER, INC.

Carl A. Tebbens

Carl A. Tebbens, P.E.
Vice President

CAT:vlt

cc: Mr. Gary Swearingen
Mr. Richard Heller
Mr. Bill Adams

To Bruno —
Info & Files
[illegible]

MEURER, SERAFINI AND MEURER, INC.
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2601 WYOMING BLVD., N.E., SUITE F • ALBUQUERQUE, NEW MEXICO 87110 • (505) 292-1936

July 23, 1979

F20-D2

RECEIVED
JUL 24 1979
CITY ENGINEER

Mr. Richard W. Krimm
Assistant Administrator for Flood Insurance
Office of Flood Insurance
U.S. Dept. of Housing & Urban Development
Washington, D.C. 20410

Re: Academy Estates, Unit 8, Albuquerque (Bernalillo County)
New Mexico IFE(218, FLO-1

Dear Mr. Krimm:

Pursuant to your request I am submitting this letter certifying that the structures constructed on Lots 24 and 46 through 60, Block 11 of the above referenced development have been constructed in reasonable conformance with the grading plan. The as-built elevations of the structures are as follows:

Lot	Finished Floor (F.F.) Elevation or Pad Elevation
24	5549.9 Pad
46	5545.1 F.F.
47	5544.6 F.F.
48	5541.9 F.F.
49	5538.6 F.F.
50	5534.3 F.F.
51	5530.4 F.F.
52	5524.3 Pad
53	5521.5 F.F.
54	5517.4 F.F.
55	5515.4 Pad
56	5514.3 F.F.
57	5513.4 F.F.
58	5511.4 Pad
59	5510.2 F.F.
60	5507.3 F.F.

Attached is a copy of the grading plan which shows the pad locations and general structure locations (rectangle shown on each lot) and the actual elevation of either the pad where the lot is vacant (Lots 24, 52, 55 and 53, Block 11) or the low finished floor elevation (F.F.)

There are no basements and in most cases where houses are already constructed there exists a 4 foot (±) high concrete block wall along the rear lot lines of the subject lots. To the best of my knowledge the concrete block wall will be complete and continuous along the rear line (adjacent to the existing water course) at such time as all houses are built and occupied.

Since the original letter requesting release of these lots from the F.I.A. flood hazard area was submitted one year ago, it is requested that the release of the above lots be made at your earliest convenience.

Very truly yours,

MERURER, SERAFINI & MEURER, INC.

Carl A. Tebbens

Carl A. Tebbens, P.E.
Vice President

CAT:dw

cc: Mr. Gary Swearingen
Mr. Richard Heller

LAW OFFICES OF
MARRON & McKINNON
406 SANDIA SAVINGS BUILDING
400 GOLD AVENUE, S.W.
ALBUQUERQUE, NEW MEXICO 87102

OWEN B. MARRON
DAN A. McKINNON, III

TELEPHONE
247-4051
AREA CODE 505

5-1-78

Copy
Bob —
Bruce —
Dwayne —
J.

28 April 1978

RECEIVED
MAY 01 1978
CITY ENGINEERS

Mr. V. M. Kimmick
City Engineer
Public Works Department
P. O. Box 1293
Albuquerque, New Mexico 87103

Re: Drainage Channel Abutting Northerly Boundary of
Academy Estates - Unit 8

Dear Mr. Kimmick:

At the suggestion of Mr. Chuck Campbell, Gordon Herkenhoff & Associates, I am restating the position of Dr. Edward on your office's suggestion that he dedicate an additional twenty-five feet on the southerly boundary of his land for the referenced drainage channel.

At the conference in your office a short time ago, it was established that on 19 July 1976 Dr. Edward dedicated seventy-five feet along the southerly border of his land for a drainage canal to accommodate to the Northeast Heights Drainage Plan, and that thereafter the City approved the subdivision plat for Academy Estates, Unit 8, which dedicated only fifty feet instead of the required seventy-five feet to conform the channel to its dimensions to the east and west of the subdivision. At that time you accepted responsibility for the lack of sufficient width of the right-of-way resulting from the dedications by Dr. Edward and the owners of the land to the south of his land.

Under the circumstances, the suggestion that Dr. Edward voluntarily dedicate additional land is unreasonable.

We trust that the City will find a better solution to the problem.

Sincerely,

OWEN B. MARRON

OBM:rbp

Cc Dr. Wm. O. Edward

MEURER, SERAFINI AND MEURER, INC.

CONSULTING ENGINEERS • SURVEYORS • PLANNERS

2601 WYOMING BLVD., N.E., SUITE F • ALBUQUERQUE, NEW MEXICO 87110 • (505) 292-1936

Steptember 28, 1977

Mr. V. M. Kimmick, City Engineer
City of Albuquerque
P. O. Box 1293
Albuquerque, New Mexico 87103

Re: Academy Estates, Unit 8

Dear Mr. Kimmick:

This is to correct a statement which I made in the letter dated September 22, 1977, regarding the above project. With further investigation I found that the plat for Academy Estates, Unit 5 has already dedicated that portion of Moon Street adjacent to Academy Estates, Unit 8; therefore, our plat which does not show a dedication for Moon Street is correct and we will not be adding the Moon Street dedication to this plat.

Should there be any additional questions regarding this project, please contact me.

Very truly yours,

MEURER, SERAFINI AND MEURER, INC.

Carl A. Tebbens

Carl A. Tebbens, P.E.
Vice President

CAT:dw

cc: Mr. Gary Swearingen
Mr. Bruno Conegliano
Mr. Q. R. Kielich

Bruno

MEURER, SERAFINI AND MEURER, INC.

CONSULTING ENGINEERS • SURVEYORS • PLANNERS

2601 WYOMING BLVD., N.E., SUITE F • ALBUQUERQUE, NEW MEXICO 87110 • (505) 292-1936

September 22, 1977

RECEIVED
SEP 26 1977
CITY ENGINEERS

Mr. V. M. Kimmick, City Engineer
City of Albuquerque
P. O. Box 1293
Albuquerque, New Mexico 87103

Re: Academy Estates Unit 8

Dear Mr. Kimmick:

At our meeting on September 21, 1977, which included yourself, Bruno Conegliano, Bob Kielich, Gary Swearingen, and myself the following major items were discussed and approved as conditions for plat approval of the above referenced development.

1. The plat boundary will be changed to include the dedication of Moon Street.

2. The plat will show dedication of that portion of the Bear Tributary within Gary's ownership (as shown on the plat).

3. A no crown temporary pavement section will be constructed on Moon Street at Galaxia Way to allow storm water from Galaxia Way to cross Moon Street and discharge onto land to the west in order to decrease flows in Camino del Sol temporarily. A curb opening will be provided on the west side of Moon Street to allow discharge of storm water. At such time as Camino del Sol is improved between Moon Street and Spain Road the temporary paving will be replaced and a normal crown section will be constructed on Moon Street.

If I do not receive written notice otherwise within a week of the date of this letter, I will assume that the above conditions are acceptable as stated.

Should you have any questions regarding this matter please contact me.

Very truly yours,

MEURER, SERAFINI, AND MEURER, INC.

Carl A. Tebbens

Carl A. Tebbens, P.E.
Vice President

CAT:dw

cc: Gary Swearingen
Bruno Conegliano
Bob Kielich

drainage file

City of Albuquerque

P.O. BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

MAYOR
Harry E. Kinney

CHIEF
ADMINISTRATIVE OFFICER
Frank A. Kleinhenz

May 27, 1977

Murray-McCormick Inc.
2601 Wyoming Blvd., N.E. Suite F
Albuquerque, New Mexico 87110

Re: Drainage Report for Academy Estates, Unit 8

Gentlemen:

I have reviewed the drainage report for Academy Estates, Unit 8, and my comments are as follows:

1. The drainage report does not address itself in a comprehensive manner to the question of the interface with this surrounding development. In particular, do the streets Estrellita del Norte, Moon, and Camino del Sol have sufficient capacity and configuration to carry the contributed flows to a satisfactory discharge point? Some of the lots in Block 11, drainage area B-1, show a drop in land elevation from front to back yard of 10 feet. How will they be made to drain into the street collection the runoff from B-1 and not adversely affect the lots in Academy Estates, Unit 4, fronting Camino del Sol?

2. As noted in my letter to this firm regarding the drainage report for Homestead Hills, I have substantial reservations regarding the values of the runoff coefficients used. I also find that this firm, in the adjacent development of Candlelight Hills, used runoff coefficients with values of 0.35 for undeveloped land and of 0.30 for lawns, etc. At least consistant values should be used in the same area. In the just mentioned report, a value of 0.825 was assigned to the land covered by asphalt or construction.

I consider this value unrealistic in a 100-year storm as it is stressed in the Ven Te Chow "Handbook of Hydrology," and as your firm recognizes in this Academy Estates drainage report. It is on the basis of these observations that I question the adequacy of the carrying capacity of the above mentioned streets.

3. Revised computations will indicate whether additional lot ponding or compensating offsite ponding needs to be provided or a combination of both. An effort will have to be made to adhere strictly to the AMAFCA Resolution Requirements, particularly in view of the fact that no improvements will be made to the Bear Canyon tributary. At a point of discharge of the runoff, precautions must be taken to insure that the energy is dissipated and no degradation will occur in the main water course.

4. Continuity of right-of-way must be maintained from the Candlelight Hills development. Figure 1 of the report does not unequivocally show that such continuity will be provided.

Most of these items have already been discussed with Mr. Carl Tebbens and many of the considerations included in my letter on the drainage report for Homestead Hills are applicable here; i.e.: Treatment of garden walls and inter-lot runoff flows.

I look forward to receiving the appropriate revisions to this report.

Very truly yours,

Bruno Conegliano

Bruno Conegliano
Assistant City Engineer-Hydrology

BC/kr

cc-Jim Smith
V. M. Kimmick
Drainage File

Genge/Murray-McCormick
2601 Wyoming Blvd., N.E. Suite F
Albuquerque, N.M. 87110/505 292-1936
Engineering · Surveying · Planning
Tucson · Phoenix · Denver · Pueblo

April 12, 1977

Bruno

RECEIVED
APR 12 1977
CITY ENGINEERS

Mr. V. M. Kimmick
City Engineer
City of Albuquerque
P. O. Box 1293
Albuquerque, New Mexico 87103

Re: Academy Estates, Unit 8

Dear Mr. Kimmick:

Enclosed are two copies of the drainage study for the above referenced project. This study is being transmitted to you for your review and approval or comments.

Should you have any questions or comments please contact me.

Very truly yours,

GENGE/MURRAY-McCORMICK, INC.

Carl A. Tebbens

Carl A. Tebbens, P.E.
Vice President

cc: Mr. Gary Swearingen

CAT:dw

DRAINAGE REPORT

FOR

ACADEMY ESTATES, UNIT 8

ALBUQUERQUE, NEW MEXICO

MURRAY-McCORMICK, INC.
ENVIRONMENTAL DESIGN

ECOSYSTEMS ANALYSIS • PLANNING • LAND SURVEYS • ENGINEERING

2601 WYOMING BLVD., NE. SUITE F / ALBUQUERQUE, N.M. 87110 / 505-292-1936

DRAINAGE REPORT

FOR

ACADEMY ESTATES, UNIT 8

ALBUQUERQUE, NEW MEXICO

Prepared By

Genge/Murray-McCormick, Inc.
2601 Wyoming Boulevard N.E.
Albuquerque, New Mexico 87110

(505) 292-1936

April 1977

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Appendix 2	Ponding Requirement
Appendix 3	Runoff Computations
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Figure II	Typical Lot Drainage
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Figure IV	Intensity Duration Frequency Curves
Figure V	Overland Flow Time
Figure VI	Velocities for Method of Estimating Tc

DRAINAGE REPORT

ACADEMY ESTATES, UNIT 8

GENERAL

This report will present the data, analysis and calculations resulting from the drainage study of the proposed single family subdivision, titled: "Academy Estates Unit 8." The lands for the proposed development were recently annexed to the City of Albuquerque. It is situated partly in Section 29 and 32, Township 11 North, Range 4 East, N.M.P.M.

The property encompasses 38.1 acres and is subdivided into 108 large (90'x130' typical size) single family lots. More precise information can be found in Figure 1.

The natural ground is covered with the grasses and shrubs native to the central New Mexico region, and slopes gently to the west approximately 3% to 4%. The site shows undulating terrain with minor swales and a well defined, natural channel of the Bear Canyon Tributary along the north boundary. It is intended that the cut and fill grading will intercept the minor flow patterns and allow the runoff to be conveyed in the street.

The site is bounded on the north by the Bear Canyon Tributary and on the east by Estrellita del Norte, N.E. The west boundary of the property is Moon Street N.E., and south boundary is Academy Estates Unit 4.

According to the Rice Report the Bear Canyon Tributary to the north of Moon Street, N.E., has an interpolated 100-year flow of 1345 cfs adjacent to the project.

Offsite flows from the east are intercepted and directed away from the proposed site by Estrellita del Norte, N.E., leaving the site free from offsite flows.

DESIGN CRITERIA

In analyzing the storm runoff, the Rational Formula, $Q = CIA\ C_f$, is used.[1]

Where:

Q = Runoff quantity in cubic feet/second.

A = Contributing area in acres.

C_f = Frequency factor for Rational Formula

I = Intensity in inches/hour for a duration equal to the time of accumulation (duration) measured in minutes and obtained from Figure IV, Intensity Duration Frequency Curves, Albuquerque Area 1961. (Note: Where a Time Concentration [Tc] is less than ten minutes from Figure III, the intensity value equal to ten minutes is employed.)

C = Runoff Coefficient (No Unit). This coefficient represents the integrated effects of infiltration, detention storage, evaporation, retention, flow routing, and interception which all affect the time distribution and peak rate of runoff.

1. See Bibliography, Item (2), Paragraph 3.7., Appendix -4.

ESTIMATED RUNOFF UNDEVELOPED STATE:

Drainage within the boundary of the site is basically overland flow with some small swales. There are no offsite flows entering the site.

The total runoff in the undeveloped site forms the basis for comparison with the flow in the developed state.

TABLE 1

RUNOFF IN UNDEVELOPED STATE

Drainage Basin	Elev. Diff.	Length of Flow	Tc Min.	I_{100} yr. In./Hr.	C[2]	Area Ac.	Q C.F.S.
ONSITE	50	1500	10	5.4	0.38	38.1	78

ESTIMATED RUNOFF DEVELOPED STATE

As development occurs, the area of impervious surfaces increases and thereby the amount of runoff also increases. To offset this increase, onsite restrictions of flows must be incorporated into the development. While this can take different forms, the most practical solution for this type of development is to utilize on-lot ponding. The contributing area to the backyard ponding includes the backyard, sideyard, and in a majority of cases, one-half of the roof area due to the popularity of the pitched roof concept. The area drained to the street includes the front yard, driveway, sidewalk-parkway areas, and one-half the roof area. This approach will satisfy AMAFCA's requirement that the runoff rate from the developed tract will not exceed the runoff rate from the tract in its natural state.

2. See Appendix 1.

The runoff coefficients, prior to the C_f adjustment, for various surfaces are as follows:

Streets, Walks and Drives	C = 0.80
Roofs	C = 0.80
Lawns, Sandy Soil (Average - 2 to 7%)	C = 0.12

TABLE 2[3].

RUNOFF IN DEVELOPED STATE

Drainage Basin	Area Ac.	C[3].	$I_{100\ year}$ In./Hr.	Q C.F.S.
ONSITE				
A-1	9.76	0.5	3.88	19
A-2	3.40	0.51	4.68	8
A-3	3.84	0.51	4.63	9
A-4	4.04	0.54	4.63	10
A-1, A-2, A-3, A-4	21.04	0.51	3.88	42
B-1	9.58	0.46	3.86	17
C-1	1.30	0.46	4.82	3
D-1	1.00	0.55	4.75	3
E-1	0.33	0.66	5.19	1
A-1 thru E-1	33.25	0.50	3.86	64

EXPLANATION OF RESULTS:

Runoff Before Development - On Site:	78 cfs
Runoff After Development - On Site:	64 cfs

3. See Appendix 3.

The net runoff result is a decrease of 14 cfs from the undeveloped state to developed state.

In the developed state, no offsite flows contribute to the site. Street carrying capacities are adequate to handle the 100-year storm runoff generated by the site.

Bear Canyon Tributary which receives much of this runoff is subject to some minor grading. The Bear Canyon Tributary has a 100-year flood hazard line, which encroaches slightly along the northerly boundary of Lots 24, 54 and 55, Block 11, based on the Rice Report. This encroachment is delineated on Figure 1. With a small amount of regrading in the form of a fill on the lots adjacent to the Bear Canyon Tributary the 100-year flood hazard will not affect said lots. Because of the very minor filling of the present flood hazard area, the flood plain will not be shifted significantly; therefore, it is recommended to leave the arroyo natural.

Runoff from Area C-1 (3.0 cfs) crosses Moon Street N.E., and drains onto the adjacent land (Academy Estates Unit 5).

Runoff from Areas A-1, A-2, A-3, and A-4 drain north into Bear Canyon Tributary. Flows from B-1 will be diverted eventually into Bear Canyon Arroyo via Moon Street. Also, storm runoff from Areas D-1 and E-1 shall be discharged onto Estrellita Del Norte, N.E.

Ponding areas, shown in Figure II, adequately retain the necessary runoff.

Ponding areas, where called for in backyards, would be best situated toward the rear of the yard. There should be a minimum of a five foot buffer zone between the rear property lines and the edge of the pond. This buffer will protect any walls which might be constructed. In no case should ponded waters be allowed to stand against the wall.

RECOMMENDATIONS

The following is a summary of the recommendations which must be incorporated in the construction drawings and field inspections at the time of construction:

1. The lots shown as ponded should be graded to store water in the rear yard.
2. Ponds should average 6" deep and the minimum surface area should not be less than 16%[4] of the total area which is drained into the pond.
3. Flows within the streets of the development are distributed enough so that no one street assumes a critical burden in carrying capacities. However, no street should be graded at less than 0.5% slope in order to insure adequate carrying capacities.
4. The Bear Canyon Tributary should have the south embankment defined by minor grading on Lots 24, 54, and 55, Block 11, to avoid flooding these lots.

4. See Appendix-2

5. Flows from Areas A-1, A-2, A-3 and A-4 shall follow street patterns and discharge north on Moon Street N.E., then discharge into Bear Canyon Tributary.

6. Runoff from Area B-1 shall drain south on Moon Street N.E., then eventually discharge into Bear Canyon Arroyo.

7. Flows leaving Area C-1 shall cross Moon Street N.E., and discharge via a valley gutter onto adjacent land known as Academy Estates Unit 5.

8. Area D-1 drains onto Estrellita Del Norte which will convey runoff into Bear Canyon Tributary.

9. Area E-1 discharges runoff onto Estrellita Del Norte going south then turning west on Camino del Sol. Runoff will discharge into the Bear Canyon Arroyo.

Respectfully submitted,

Carl A. Tebbens
N.M.P.E. No. 6309

BIBLIOGRAPHY OF REFERENCES

(1) Herkenhoff, Gordon & Associates, "Master Plan of Drainage City of Albuquerque, New Mexico and Environs, 1963". Albuquerque; Gordon Herkenhoff & Associates, Consulting Engineers.

(2) Wright-McLaughlin Engineers, "Urban Storm Drainage Criteria Manual, Volume 1", Denver, Colorado: Wright-McLaughlin Engineers, 1969.

(3) U.S. Department of Commerce, "Technical Paper, No. 40, Rainfall Frequency Atlas of the United States", Washington, D.C., U.S. Government Printing Office, 1963.

APPENDIX

APPENDIX-1

COMPOSITE RUNOFF COEFFICIENTS

Undeveloped Land

$C = 0.31^{1.} \times 1.25^{2.} = 0.38$

Developed Land

Typical Lot Area

Gross Area		38.1 Ac.
Less: Area in Streets	5.6 Ac.	
Area in Lots		32.5 Ac.
Average Lot Area (108 Lots)		13,100 Sq.Ft.
Typical Lot Width		90 Ft.

Ponded Lots

C = 0.80	Streets & Walk Area	20x90	1,800 Sq.Ft.
	Roof Area	25x65	1,625 Sq.Ft.
	Driveway	30x20	600 Sq.Ft.
	Total Impervious Area		4,025 Sq.Ft.
C = 0.12	Front and Side Yares	90x55	4,950 Sq.Ft.
	Less Roof Area	25x65	-1,625 Sq.Ft.
	Less Driveway	30x20	-600 Sq.Ft.
	Total Pervious Area		2,725 Sq.Ft.

Impervious Area	4,025 Sq.Ft. 59.6% @ 0.80	0.48
Pervious Area	2,725 Sq.Ft. 40.4% @ 0.12	0.05
Total Area	6,750 Sq.Ft. 100%	0.53

Composite Runoff Coefficient - $C \times C_f = 0.53 \times 1.25 - 0.66$

1. See Bibliography, Item (1) Table XII
2. See Bibliography, Item (4) Article 3.7, Appendix-4

Non-Ponded Lots

C = 0.80	Streets & Walk Area	20x90	1,800 Sq.Ft.
	Roof Area	50x65	3,250 Sq.Ft.
	Driveway	30x20	600 Sq.Ft.
	Total Impervious Area		5,650 Sq.Ft.
C = 0.12	Total Lot Area		13,100 Sq.Ft.
	Less Roof Area		-3,250 Sq.Ft.
	Less Driveway		-600 Sq.Ft.
	Total Pervious Area		9,250 Sq.Ft.

Impervious Area	5,650 Sq.Ft.	37.9% @ 0.80	0.30
Pervious Area	9,250 Sq.Ft.	62.1% @ 0.12	0.070
Total Area	14,900 Sq.Ft.	100%	0.37

Composite Runoff Coefficient - $C \times C_f = 0.37 \times 1.25 = 0.46$

APPENDIX-2

Ponding Requirements

Average Lot Area		13,100 Sq.Ft.
1/2 Roof Area	25x65	1,625 Sq.Ft.
Patio Area	15x15	225 Sq.Ft.
Rear Lawn Area		5,350 Sq.Ft.
Total Area Draining to Pond		7,200 Sq.Ft.

Runoff Coefficient

Impervious Area:

$$C = 0.80 \frac{1850}{7200} = 0.26$$

Pervious Area:

$$C = 0.12 \frac{5350}{7200} = \frac{0.09}{0.35}$$

$$C \times C_f = 0.35 \times 1.25 = 0.44$$

Pond Volume Requirements:

100 year 6-hour precipitation = 2.2 inch

Volume = Runoff Coefficient x Area X Precipitation

$V = 2.2/12 \times 0.44 \times 7200 = 580.8$ ft.^{3}

Depth of Pond 0.50 ft. (6")

Minimum Area of Pond = 1162 ft.^{2}

Pond area as a percentage of area drained - 16.2%

$V = 16.2 \times 7200 \times 0.5 = 357$ ft.^{3} area of pond = 584 ft.^{2} @ 0.5' deep.

SUBDIVISION ACADEMY ESTATES UNIT 8
LOCATION ALBUQUERQUE, N.M.
JOB NO.
DESIGN STORM 100 YR. RECURRENCE INTERVAL
MAJOR STORM 100 YR.
COMPUTATIONS BY S.S. DATE 3/29/77

RUNOFF COMPUTATIONS
(Rational Method)

APPENDIX - 3

Area Designation	A (Acres)	c	c_f	$\bar{c}$ = (c x c_f)	A·$\bar{c}$	ΣA·$\bar{c}$	tc (min)	I (in/hr)	Q = (ΣA·$\bar{c}$) x I cfs	Street capacity cfs	Flow in Pipe cfs	Pipe Dia. in.	Slope %	Length ft.	VEL V fps	Δt (min)	'C'
A-1	9.76	0.08 0.32	1.25	0.50	4.88	4.88	23.7	3.88	18.9	120	-	-	2.28	1840	3.0	10.2	14.29% P @ 0.5 85.71% NP @ 0.3
A-2	3.4	0.14 0.27	1.25	0.51	1.73	1.73	15.4	4.68	8.1	139	-	-	3.0	400	3.5	1.9	27.27% P @ 0.5 72.73% NP @ 0.3
A-3	3.84	0.15 0.26	1.25	0.51	1.96	1.96	15.8	4.63	9.1	135	-	-	2.9	480	3.4	2.3	28.57% P @ 0.5 71.43% NP @ 0.3
A-4	4.04	0.19 0.24	1.25	0.54	2.18	2.18	15.8	4.63	10.1	98	-	-	1.5	550	2.45	3.7	35.71% P @ 0.5 64.29% NP @ 0.
B-1	9.58	0.37	1.25	0.46	4.41	4.41	24.0	3.86	17.0	133	-	-	2.75	1300	2.7	8.0	-
C-1	1.30	0.37	1.25	0.46	0.60	0.60	14.2	4.82	2.9	98	-	-	1.5	400	2.5	2.7	-
D-1	1.0	0.44	1.25	0.55	0.55	0.50	14.8	4.75	2.6	89	-	-	1.25	640	2.2	4.8	83.33% P @ 0.5 16.67% NP @ 0.3
E-1	0.33	0.53	1.25	0.66	0.22	0.20	11.4	5.19	1.1	139	-	-	3.0	300	3.5	1.4	Ponded Lots @ 0.53
A-1 → A-4	21.04	0.13 0.28	1.25	0.51	10.73	10.73	23.7	3.88	41.6	120	-	-	2.28	1840	3.0	10.2	24.62% P @ 0.5 75.38% NP @ 0.3
A-1 → E-1	33.25		1.25	0.50	16.63	16.63	24.0	3.86	64.0	133	-	-	2.75	1840	2.7	10.2	23.15% P @ 0.5 76.85% NP @ 0.3

3.6 Continued

TABLE 3-2 (8)

RATIONAL METHOD RUNOFF COEFFICIENTS FOR COMPOSITE ANALYSIS

Character of Surface	Runoff Coefficients
Streets:	
Asphaltic	0.70 to 0.95
Concrete	0.80 to 0.95
Drives and Walks	0.75 to 0.85
Roofs	0.75 to 0.95
Lawns, Sandy Soil:	
Flat, 2%	0.05 to 0.10
Average, 2 to 7%	0.10 to 0.15
Steep, 7%	0.15 to 0.20
Lawns, Heavy Soil:	
Flat, 2%	0.15 to 0.20
Average, 2 to 7%	0.20 to 0.25
Steep, 7%	0.25 to 0.35

The coefficients in these two tabulations are applicable for storms of 5-year to 10-year frequencies. Less frequent higher-intensity storms will require modification of the coefficient because infiltration and other losses have a proportionally smaller effect on runoff, as given in the following section.

3.7 Adjustment for Infrequent Storms

The adjustment of the Rational Method for use with major storms can be made by multiplying the right side of the Rational Formula by a frequency factor C_f, which is used to account for antecedent precipitation conditions. The Rational Formula now becomes:

$$Q = CIAC_f \qquad (3\text{-}2)$$

The following table of C_f values can be used. The product of C times C_f should not exceed 1.0.

1-15-69

3.7 Continued

TABLE 3-3

FREQUENCY FACTORS FOR RATIONAL FORMULA

Recurrence Interval (years)	C_f
2 to 10	1.0
25	1.1
50	1.2
100	1.25

FACE TO FACE = ? 32
CURB = ? 8
CROWN = ? 8

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	7.1111	33.3703	.0050	.0707	.2131	.3568	2.4998	17.7719
.0150	7.1111	33.3703	.0100	.1000	.2131	.3568	3.5344	25.1333
.0150	7.1111	33.3703	.0150	.1225	.2131	.3568	4.3287	30.7819
.0150	7.1111	33.3703	.0200	.1414	.2131	.3568	4.9984	35.5439
.0150	7.1111	33.3703	.0250	.1581	.2131	.3568	5.5883	39.7392
.0150	7.1111	33.3703	.0300	.1732	.2131	.3568	6.1217	43.5322
.0150	7.1111	33.3703	.0350	.1871	.2131	.3568	6.6122	47.0201
.0150	7.1111	33.3703	.0400	.2000	.2131	.3568	7.0687	50.2666

FACE TO FACE = ? 32
CURB = ? 8
CROWN = ? 6

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	10.6667	33.3542	.0050	.0707	.3198	.4676	3.2759	34.9430
.0150	10.6667	33.3542	.0100	.1000	.3198	.4676	4.6328	49.4169
.0150	10.6667	33.3542	.0150	.1225	.3198	.4676	5.6740	60.5231
.0150	10.6667	33.3542	.0200	.1414	.3198	.4676	6.5518	69.8660
.0150	10.6667	33.3542	.0250	.1581	.3198	.4676	7.3252	78.1350
.0150	10.6667	33.3542	.0300	.1732	.3198	.4676	8.0243	85.5926
.0150	10.6667	33.3542	.0350	.1871	.3198	.4676	8.6672	92.4505
.0150	10.6667	33.3542	.0400	.2000	.3198	.4676	9.2657	98.8338

FACE TO FACE = ? 32
CURB = ? 8
CROWN = ? 4

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	14.2222	33.3426	.0050	.0707	.4265	.5666	3.9694	56.4537
.0150	14.2222	33.3426	.0100	.1000	.4265	.5666	5.6136	79.8375
.0150	14.2222	33.3426	.0150	.1225	.4265	.5666	6.8752	97.7806
.0150	14.2222	33.3426	.0200	.1414	.4265	.5666	7.9388	112.9073
.0150	14.2222	33.3426	.0250	.1581	.4265	.5666	8.8752	126.2342
.0150	14.2222	33.3426	.0300	.1732	.4265	.5666	9.7230	138.2827
.0150	14.2222	33.3426	.0350	.1871	.4265	.5666	10.5020	149.3623
.0150	14.2222	33.3426	.0400	.2000	.4265	.5666	11.2272	159.6751

FACE TO FACE = ? 32
CURB = ? 8
CROWN = ? 2

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	17.7778	33.3356	.0050	.0707	.5333	.6576	4.6067	81.8972
.0150	17.7778	33.3356	.0100	.1000	.5333	.6576	6.5149	115.8201
.0150	17.7778	33.3356	.0150	.1225	.5333	.6576	7.9791	141.8501
.0150	17.7778	33.3356	.0200	.1414	.5333	.6576	9.2134	163.7944
.0150	17.7778	33.3356	.0250	.1581	.5333	.6576	10.3009	183.1277
.0150	17.7778	33.3356	.0300	.1732	.5333	.6576	11.2841	200.6064
.0150	17.7778	33.3356	.0350	.1871	.5333	.6576	12.1882	216.6796
.0150	17.7778	33.3356	.0400	.2000	.5333	.6576	13.0298	231.6403

FACE

FACE TO FACE = ? 40
CURB = ? 8
CROWN = ? 2

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	8.8889	41.3629	.0050	.0707	.2149	.3588	2.5133	22.3400
.0150	8.8889	41.3629	.0100	.1000	.2149	.3588	3.5543	31.5936
.0150	8.8889	41.3629	.0150	.1225	.2149	.3588	4.3531	38.6941
.0150	8.8889	41.3629	.0200	.1414	.2149	.3588	5.0265	44.6801
.0150	8.8889	41.3629	.0250	.1581	.2149	.3588	5.6198	49.9539
.0150	8.8889	41.3629	.0300	.1732	.2149	.3588	6.1562	54.7217
.0150	8.8889	41.3629	.0350	.1871	.2149	.3588	6.6494	59.1062
.0150	8.8889	41.3629	.0400	.2000	.2149	.3588	7.1086	63.1872

FACE TO FACE = ? 40
CURB = ? 8
CROWN = ? 6

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	13.3333	41.3500	.0050	.0707	.3225	.4702	3.2940	43.9198
.0150	13.3333	41.3500	.0100	.1000	.3225	.4702	4.6584	62.1119
.0150	13.3333	41.3500	.0150	.1225	.3225	.4702	5.7053	76.0713
.0150	13.3333	41.3500	.0200	.1414	.3225	.4702	6.5880	87.8396
.0150	13.3333	41.3500	.0250	.1581	.3225	.4702	7.3656	98.2076
.0150	13.3333	41.3500	.0300	.1732	.3225	.4702	8.0686	107.5810
.0150	13.3333	41.3500	.0350	.1871	.3225	.4702	8.7151	116.2002
.0150	13.3333	41.3500	.0400	.2000	.3225	.4702	9.3168	124.2239

FACE TO FACE = ? 40
CURB = ? 8
CROWN = ? 4

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	17.7778	41.3407	.0050	.0707	.4300	.5697	3.9910	70.9506
.0150	17.7778	41.3407	.0100	.1000	.4300	.5697	5.6441	100.3393
.0150	17.7778	41.3407	.0150	.1225	.4300	.5697	6.9126	122.8901
.0150	17.7778	41.3407	.0200	.1414	.4300	.5697	7.9819	141.9012
.0150	17.7778	41.3407	.0250	.1581	.4300	.5697	8.9241	158.6504
.0150	17.7778	41.3407	.0300	.1732	.4300	.5697	9.7758	173.7928
.0150	17.7778	41.3407	.0350	.1871	.4300	.5697	10.5591	187.7177
.0150	17.7778	41.3407	.0400	.2000	.4300	.5697	11.2882	200.6787

FACE TO FACE = ? 40
CURB = ? 8
CROWN = ? 2

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	22.2222	41.3352	.0050	.0707	.5376	.6612	4.6315	102.9828
.0150	22.2222	41.3352	.0100	.1000	.5376	.6612	6.5500	145.5549
.0150	22.2222	41.3352	.0150	.1225	.5376	.6612	8.0220	178.2676
.0150	22.2222	41.3352	.0200	.1414	.5376	.6612	9.2631	205.8457
.0150	22.2222	41.3352	.0250	.1581	.5376	.6612	10.3564	230.1435
.0150	22.2222	41.3352	.0300	.1732	.5376	.6612	11.3449	252.1064
.0150	22.2222	41.3352	.0350	.1871	.5376	.6612	12.2539	272.3082
.0150	22.2222	41.3352	.0400	.2000	.5376	.6612	13.0999	291.1098

0.655 / 1.215 / 3

CROWN = ? 2

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	9.7778	45.3603	.0050	.0707	.2156	.3595	2.5184	24.6242
.0150	9.7778	45.3603	.0100	.1000	.2156	.3595	3.5615	34.8239
.0150	9.7778	45.3603	.0150	.1225	.2156	.3595	4.3620	42.6504
.0150	9.7778	45.3603	.0200	.1414	.2156	.3595	5.0396	49.2694
.0150	9.7778	45.3603	.0250	.1581	.2156	.3595	5.6313	55.0614
.0150	9.7778	45.3603	.0300	.1732	.2156	.3595	6.1688	60.3158
.0150	9.7778	45.3603	.0350	.1871	.2156	.3595	6.6630	65.1496
.0150	9.7778	45.3603	.0400	.2000	.2156	.3595	7.1231	69.6476

FACE TO FACE = ? 44
CURB = ? 8
CROWN = ? 6

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	14.6667	45.3485	.0050	.0707	.3234	.4712	3.3006	48.4087
.0150	14.6667	45.3485	.0100	.1000	.3234	.4712	4.6677	68.4602
.0150	14.6667	45.3485	.0150	.1225	.3234	.4712	5.7168	83.8463
.0150	14.6667	45.3485	.0200	.1414	.3234	.4712	6.6012	96.8173
.0150	14.6667	45.3485	.0250	.1581	.3234	.4712	7.3803	108.2451
.0150	14.6667	45.3485	.0300	.1732	.3234	.4712	8.0848	118.5765
.0150	14.6667	45.3485	.0350	.1871	.3234	.4712	8.7325	128.0773
.0150	14.6667	45.3485	.0400	.2000	.3234	.4712	9.3355	136.9204

FACE TO FACE = ? 44
CURB = ? 8
CROWN = ? 4

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	19.5556	45.3401	.0050	.0707	.4313	.5709	3.9989	78.2002
.0150	19.5556	45.3401	.0100	.1000	.4313	.5709	5.6553	110.5918
.0150	19.5556	45.3401	.0150	.1225	.4313	.5709	6.9263	135.4468
.0150	19.5556	45.3401	.0200	.1414	.4313	.5709	7.9978	156.4005
.0150	19.5556	45.3401	.0250	.1581	.4313	.5709	8.9418	174.8610
.0150	19.5556	45.3401	.0300	.1732	.4313	.5709	9.7952	191.5507
.0150	19.5556	45.3401	.0350	.1871	.4313	.5709	10.5800	206.8984
.0150	19.5556	45.3401	.0400	.2000	.4313	.5709	11.3105	221.1837

FACE TO FACE = ? 44
CURB = ? 8
CROWN = ? 2

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	24.4444	45.3350	.0050	.0707	.5392	.6625	4.6406	113.4376
.0150	24.4444	45.3350	.0100	.1000	.5392	.6625	6.5626	160.4250
.0150	24.4444	45.3350	.0150	.1225	.5392	.6625	8.0378	196.4797
.0150	24.4444	45.3350	.0200	.1414	.5392	.6625	9.2813	226.8752
.0150	24.4444	45.3350	.0250	.1581	.5392	.6625	10.3768	253.6542
.0150	24.4444	45.3350	.0300	.1732	.5392	.6625	11.3672	277.8642
.0150	24.4444	45.3350	.0350	.1871	.5392	.6625	12.2779	300.1276
.0150	24.4444	45.3350	.0400	.2000	.5392	.6625	13.1257	320.8500

0.669 / 1.227 / 3

FACE TO FACE = ? 48
CORE = ? 8
CROWN = ? 8

X	A	P	S	S1/2	R	R2/3	V	Q
.0150	10.6667	49.3580	.0050	.0707	.2161	.3601	2.5927	26.9084
.0150	10.6667	49.3580	.0100	.1000	.2161	.3601	3.5677	38.0543
.0150	10.6667	49.3580	.0150	.1225	.2161	.3601	4.3694	46.6065
.0150	10.6667	49.3580	.0200	.1414	.2161	.3601	5.0453	53.8159
.0150	10.6667	49.3580	.0250	.1581	.2161	.3601	5.6409	60.1691
.0150	10.6667	49.3580	.0300	.1732	.2161	.3601	6.1792	65.9180
.0150	10.6667	49.3580	.0350	.1871	.2161	.3601	6.6743	71.1931
.0150	10.6667	49.3580	.0400	.2000	.2161	.3601	7.1352	76.1086

FACE TO FACE = ? 48
CORE = ? 8
CROWN = ? 6

X	A	P	S	S1/2	R	R2/3	V	Q
.0150	16.0000	49.3472	.0050	.0707	.3242	.4720	3.3061	52.8978
.0150	16.0000	49.3472	.0100	.1000	.3242	.4720	4.4755	74.5088
.0150	16.0000	49.3472	.0150	.1225	.3242	.4720	5.3864	91.6216
.0150	16.0000	49.3472	.0200	.1414	.3242	.4720	6.6122	105.7955
.0150	16.0000	49.3472	.0250	.1581	.3242	.4720	7.3927	118.2830
.0150	16.0000	49.3472	.0300	.1732	.3242	.4720	8.0983	129.5726
.0150	16.0000	49.3472	.0350	.1871	.3242	.4720	8.7471	139.9544
.0150	16.0000	49.3472	.0400	.2000	.3242	.4720	9.3511	149.6175

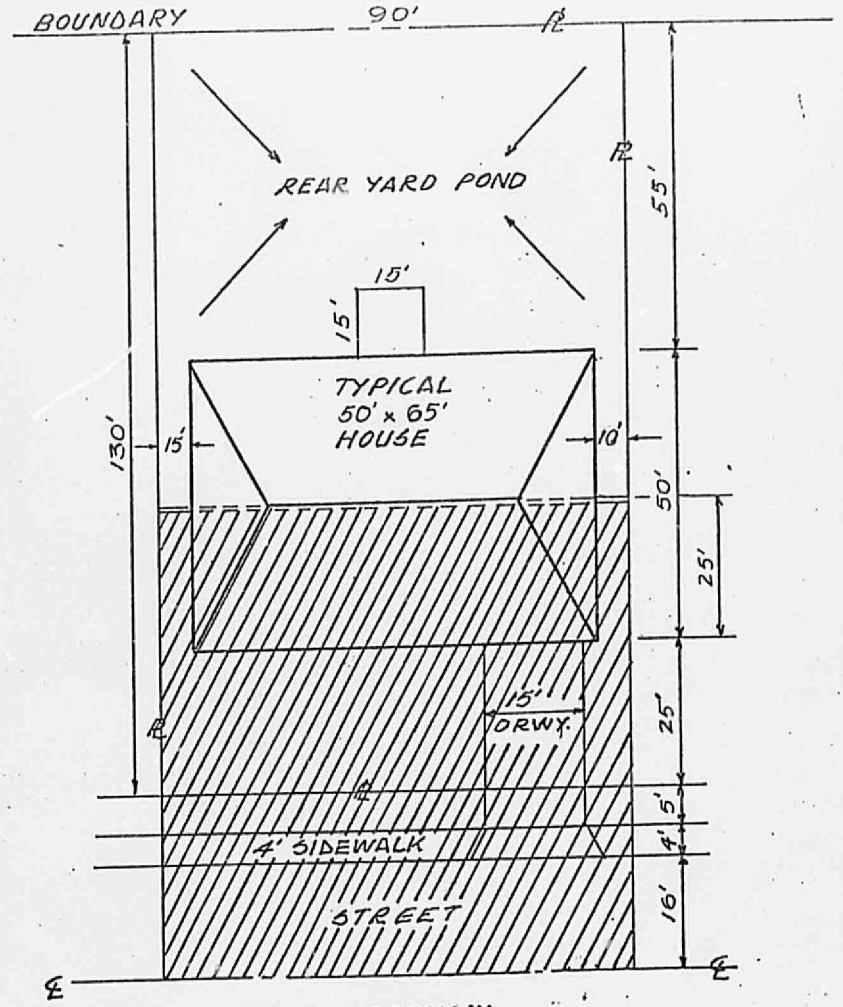
FACE TO FACE = ? 48
CORE = ? 8
CROWN = ? 4

X	A	P	S	S1/2	R	R2/3	V	Q
.0150	21.3333	49.3395	.0050	.0707	.4324	.5718	4.0055	85.4504
.0150	21.3333	49.3395	.0100	.1000	.4324	.5718	5.6646	120.8451
.0150	21.3333	49.3395	.0150	.1225	.4324	.5718	6.9377	148.0044
.0150	21.3333	49.3395	.0200	.1414	.4324	.5718	8.0110	170.9007
.0150	21.3333	49.3395	.0250	.1581	.4324	.5718	8.9565	191.0728
.0150	21.3333	49.3395	.0300	.1732	.4324	.5718	9.8114	209.3098
.0150	21.3333	49.3395	.0350	.1871	.4324	.5718	10.5975	226.0804
.0150	21.3333	49.3395	.0400	.2000	.4324	.5718	11.3292	241.6901

FACE TO FACE = ? 48
CORE = ? 8
CROWN = ? 2

X	A	P	S	S1/2	R	R2/3	V	Q
.0150	26.6667	49.3349	.0050	.0707	.5405	.6636	4.6482	123.9539
.0150	26.6667	49.3349	.0100	.1000	.5405	.6636	6.5736	175.2963
.0150	26.6667	49.3349	.0150	.1225	.5405	.6636	8.0510	214.6932
.0150	26.6667	49.3349	.0200	.1414	.5405	.6636	9.2965	247.9064
.0150	26.6667	49.3349	.0250	.1581	.5405	.6636	10.3938	277.1678
.0150	26.6667	49.3349	.0300	.1732	.5405	.6636	11.3858	303.6221
.0150	26.6667	49.3349	.0350	.1871	.5405	.6636	12.2981	327.9493
.0150	26.6667	49.3349	.0400	.2000	.5405	.6636	13.1472	350.5926

0.663 / 1.229 / 3



NOTE: REFER APPENDIX FOR CALCULATION

AREA DRAINED

FIGURE II
TYPICAL LOT DRAINAGE

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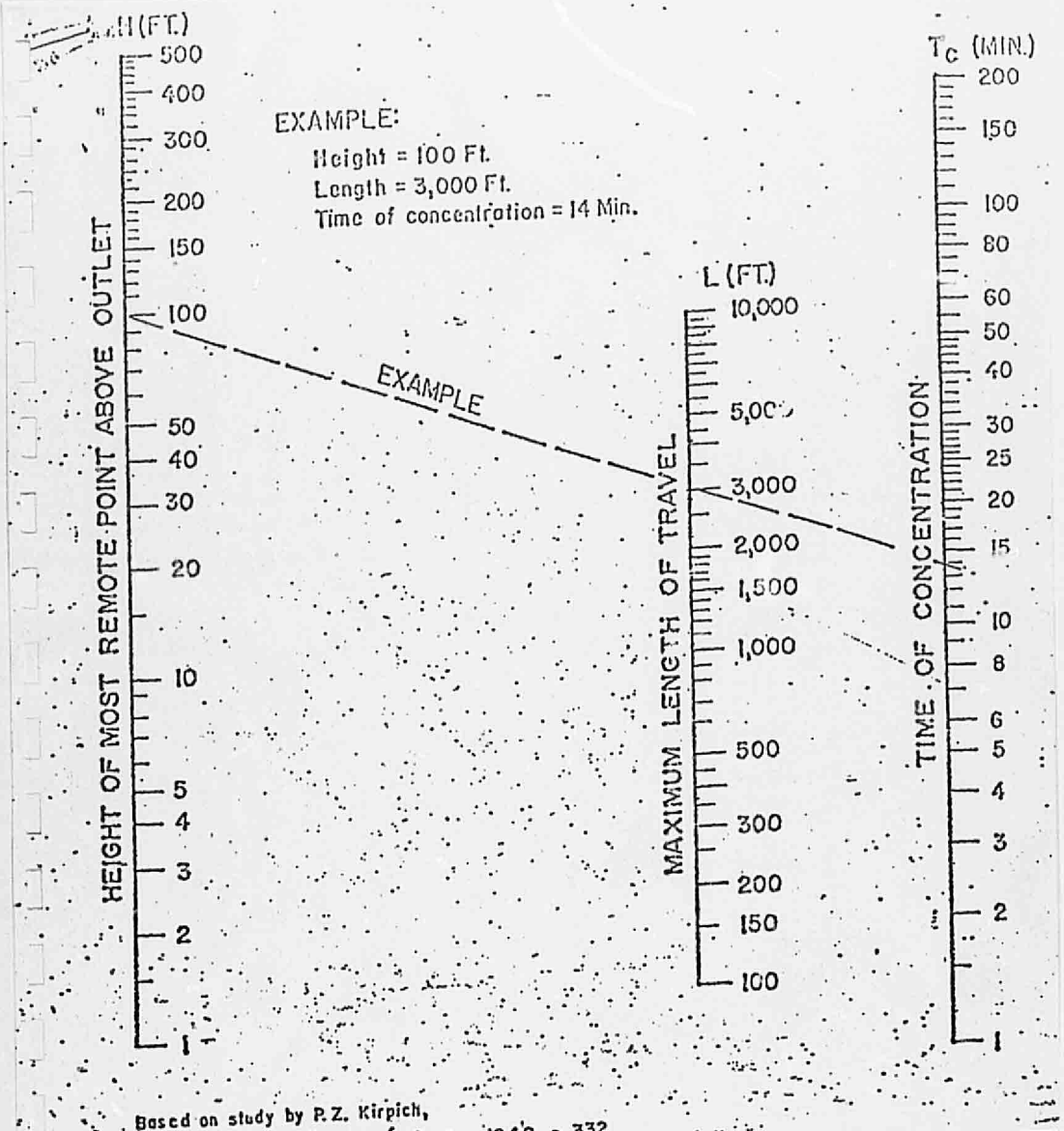
JOB NO. _____ DATE _____
PROJECT _____
_____ SCALE _____



Based on study by P. Z. Kirpich,
Civil Engineering, Vol. 10, No. 6, June 1940, p. 332

TIME OF CONCENTRATION OF SMALL DRAINAGE BASINS

FIG. III

Reprinted from "Design of Roadside Drainage Channels - Hydraulic Engineering

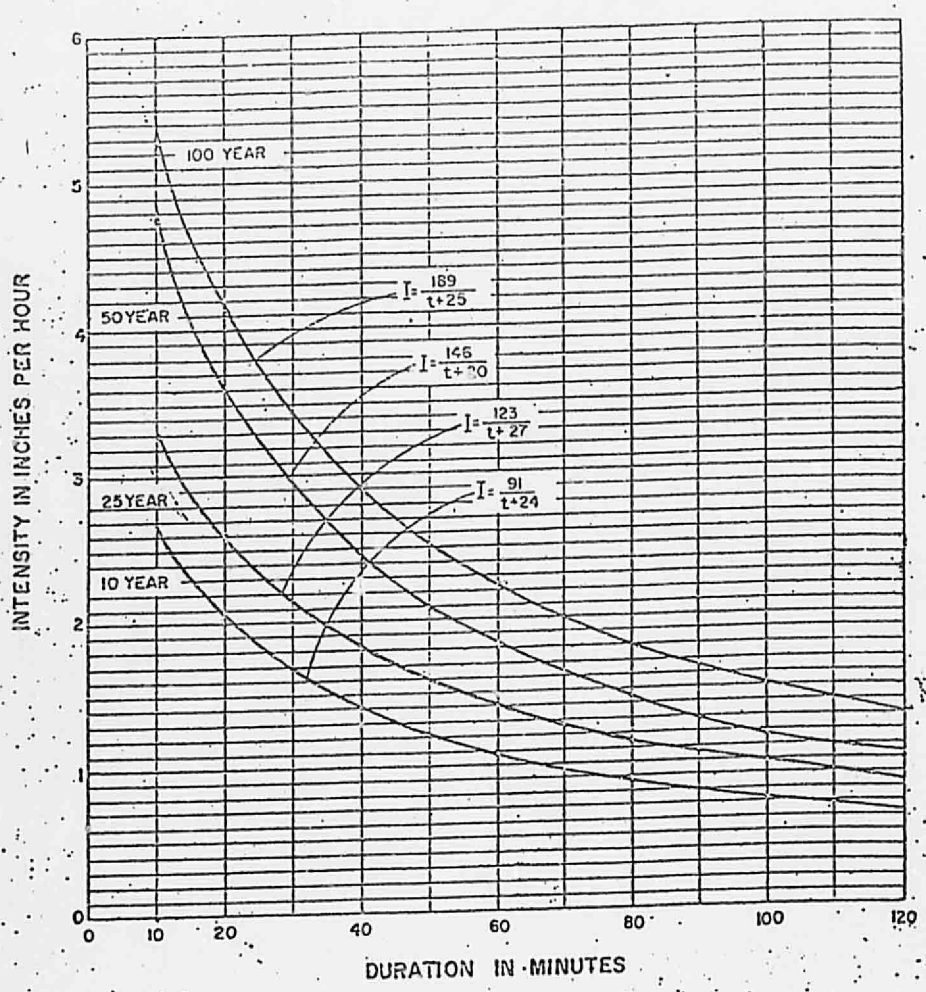


FIGURE IV

MASTER PLAN OF DRAINAGE
CITY OF ALBUQUERQUE - NEW MEXICO
AND ENVIRONS

INTENSITY DURATION
FREQUENCY CURVES

(ALBUQUERQUE AREA-1961)

GORDON KEKKENHOFF & ASSOC
CONSULTING ENGINEERS
ALBUQUERQUE, NEW MEXICO

CHART
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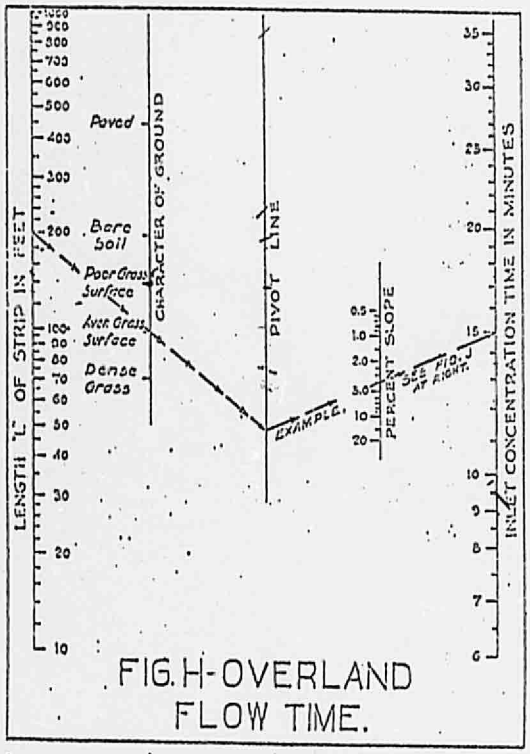

FIG. H-OVERLAND FLOW TIME.

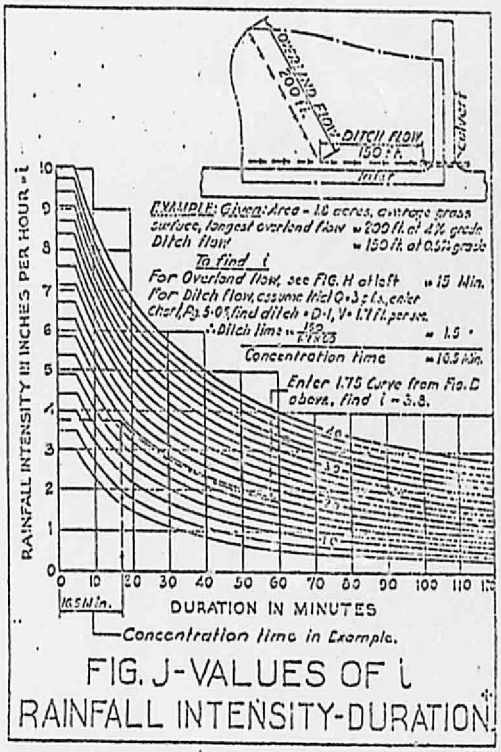

FIG. J-VALUES OF i
RAINFALL INTENSITY-DURATION*

*Reproduced from Miscellaneous Publication No. 204, U.S. Dept. of Agriculture, by David L. Yarnell.
*Adapted from Engineering Manual of the War Department; Part XIII, Chap. I, Dec. '45.

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JOB NO. _____ DATE _____
PROJECT _____
SCALE _____

FIGURE V

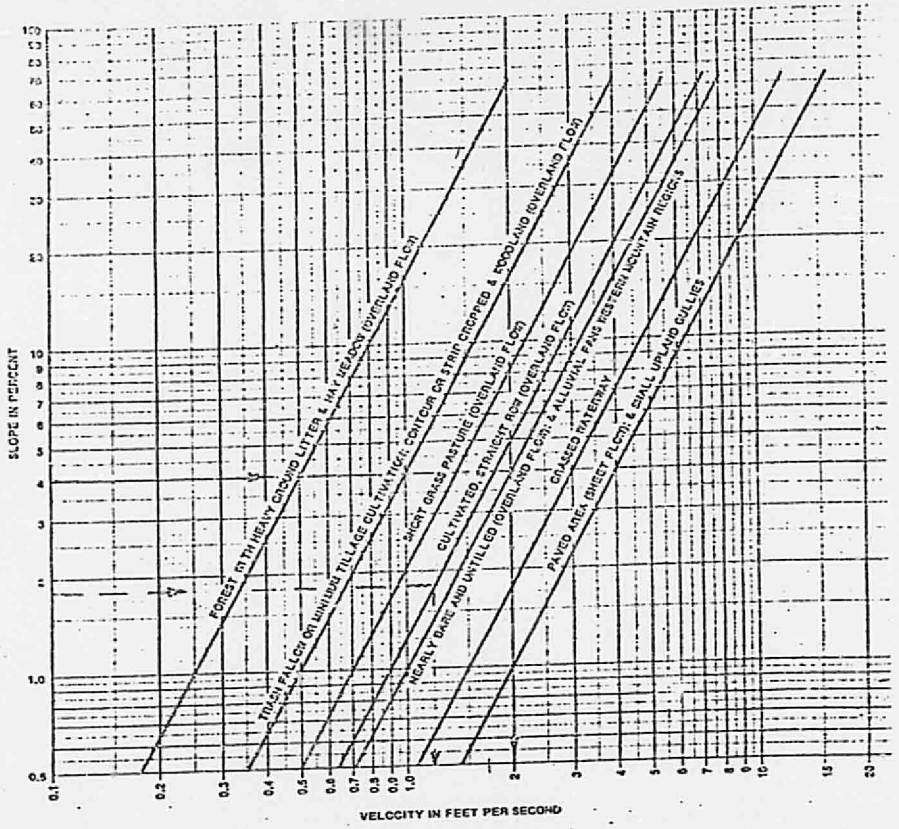

FIGURE VI

-Velocities for upland method of estimating T_c