HYDROLOGY E20/D5 THREE PLANS

E20/D5

3 Plans

V.M. Kimmick

Genge/Murray-McCormick

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

Bruno —

August 8, 1977

Mr. Jim Smith
Albuquerque Metropolitan Arroyo
Flood Control Authority
2600 Prospect N.E.
Albuquerque, New Mexico 87106

Re: Cherry Hills - Unit 2

Dear Jim:

Pursuant to our meeting of July 12, 1977 with Messrs. V. M. Kimmick and Bruno Conegliano we hereby request your approval of the Cherry Hills - Unit 2 plat of Subdivision and Drainage Study.

As you will recall four conditions were placed upon that approval.

1. Agreement by Associated Investment Company, its successors and assigns to maintain the temporary interceptor channels. A letter to that effect is attached hereto.

2. A temporary easement providing for the discharge of surface waters across the lands of the Albuquerque Academy. The draft has been submitted to the Academy, A.M.A.F.C.A. and the City on July 20, 1977. The Academy through Mr. Jim Kirkpatric has acknowledged approval of the concept and further, that the document execution would have to wait for the return of the Board late in August. As actual improvement of this project would be contingent upon receipt of this document, we request your approval through the platting process only.

3. A letter from the Dale Bellamah Corporation indicating that the entire area surrounding the North Arroyo Del Pino will be deeded to the City for a public Park. A letter to that effect under the date of July 26, 1977 and signed by Mr. Terrance L. Connors is attached hereto.

4. The relocation of the Ventura interceptor channel eastward out of the right-of-way thus allowing northward vehicular travel within the existing dedicated public R.O.W. As I indicated in our phone conversation of August 3, 1977, the city has acknowledged through Bob Fousnough that they will install a Temporary Pavement connection between the Cherry Hills and Heritage Hills permanent Improvements. The stated purpose of the Temporary Paving is to provide traffic

circulation until definite plans can be laid for the type of Arroyo crossing and channel improvements to be designed with the development of the park site. With this concept in mind, it is our desire to continue the temporary interceptor as previously designed to the North Pino Arroyo within the east one-half of the Ventura right-of-way as shown in the Drainage Report and on the Engineering Plans.

Your consideration of our request and acknowledgement to Mr. Conegliano would be greatly appreciated

Very truly yours,

GENGE/MURRAY-McCORMICK, INC.

Thomas J. Hauck
Project Engineer

TJH:an

ASSOCIATED INVESTMENT COMPANY OF EL PASO, TEXAS • 420 Texas Avenue

ADDRESS REPLY TO:
P. O. Box 1463, El Paso, Texas 79999
Telephone: 533-3423 Area Code 915

August 8, 1977

City of Albuquerque
Department of Public Works
Engineering Division
P. O. Box 1293
Albuquerque, New Mexico, 87103

Attention: Mr. V. M. Kimmick
City Engineer

RE: Cherry Hills Subdivision, Unit 2

Gentlemen:

Pursuant to your request, Associated Investment, its successors and assigns hereby agree to maintain the temporary interceptor channels to be constructed adjacent to Harper Road and Ventura Road as outlined and shown in the Engineering Plans for Cherry Hills - Unit 2 as prepared by Genge/Murray-McCormick under the date of May 4, 1977. Said maintenance shall continue until such time as the paving improvement of the south one-half of Harper Road and the east one-half of Ventura is installed by or under the direction of the City of Albuquerque.

Very truly yours,

ASSOCIATED INVESTMENT COMPANY

J. E. Wilson
Assistant Vice President

JW/er

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

July 20, 1977

Albuquerque Academy
6400 Wyoming Blvd. N.E.
Albuquerque, New Mexico 87109

Attention: Mr. James Kirkpatrick
Business Manager

Re: Cherry Hills Subdivision

Dear Mr. Kirkpatrick:

Attached is a draft of the agreement for a temporary easement for drainage purposes being requested by A.M.A.F.C.A. and the City of Albuquerque. We would appreciate the review and approval of this document by the Academy at your earliest convenience.

Please note that the easement is temporary in term and flexible in alignment. Further that the flow being conveyed therein is specifically to be conveyed to the existing drainage easement at Rosewood and Harper at the time the south one-half of Harper is paved. Note the provision for the automatic vacation upon the installation of this improvement.

As this is a draft, we would appreciate your acknowledgement as to the proper signatories and notary such that they may be added to the original for submittal and execution.

Should you have any questions or wish to make amendments, please feel free to contact me.

Very truly yours,

GENGE/MURRAY-McCORMICK, INC.

Thomas J. Haack

TJH:dw

cc: Mortgage Investment Co.
A.M.A.F.C.A.
City of Albuquerque

LETTER OF AGREEMENT FOR DRAINAGE EASEMENT

THIS AGREEMENT made this _____ day of _____, 1977, by and between the ALBUQUERQUE ACADEMY and the CITY OF ALBUQUERQUE granting the City of Albuquerque a temporary easement to carry storm water runoff southwesterly across the lands of the Albuquerque Academy Campus, City of Albuquerque, County of Bernalillo, State of New Mexico, to the Arroyo Del Pino from the outlet of a proposed temporary drainage channel (Sta. 32+00) located within the south 1/2 of the right-of-way of Harper Road N.E. Said temporary channel shown on the engineering drawing sheet No. 14 of 14, Cherry Hills Unit 1 (East), prepared by Murray-McCormick, Inc., under the date of May 23, 1977, and further as shown on Figure No. 4 of Cherry Hills, Unit 2, Comprehensive Drainage Report prepared by Murray-McCormick, Inc., under the date of April 18, 1977, as attached hereto and made a part hereof.

It is understood and agreed that said easement shall be considered to follow the course of natural drainage along a minor arroyo, shall be twenty feet (20 ft.) in width, ten feet (10 ft.) either side of the flow line and shall extend from the south right-of-way line of Harper Road N.E., to the north line of the existing two hundred foot (200 ft.) wide drainage and utility easement of the Arroyo Del Pino.

It is further understood and agreed that upon the paving of the south portion of the right-of-way of Harper Road N.E., the flows within this easement shall be conveyed by said pavement to the existing twenty foot (20 ft.) drainage easement traversing the lands of the Albuquerque Academy Campus at or near the intersection of Rosewood Road N.E. and Harper Road N.E., and that the easement granted herein shall cease to exist.

The provisions hereof shall inure to the benefit of and bind the heirs, executors, administrators, successors and assigns of the parties hereto.

Copy for Tom Haack

DALE BELLAMAH CORPORATION

POST OFFICE BOX 3325
6400 UPTOWN BOULEVARD, N.E.
EAST TOWER, SUITE 600

ALBUQUERQUE, NEW MEXICO 87110
TELEPHONE (505) 299-7631

July 26, 1977

Mr. Bob Burgan
Director
Parks and Recreation Department
City of Albuquerque
P.O. Box 1293
Albuquerque, NM 87103

RE: Park Dedication for Heritage Hills

Dear Bob:

Attached are two copies of the plat for Heritage Hills Unit 2 showing the final configuration for the park area and drainage easement on the southern boundary which we have previously discussed. The area which lies outside of the drainage easement is approximately 5.426 acres. Listed below is a breakdown of our park dedication requirements for the various units in Heritage Hills:

Heritage Hills Park Dedication Requirements

Unit	Number of Lots	
1	174	
2	258	
3	123	
4	258	
5	35	
	848	DU
18.68 Acres of R-1 North of Domingo Baca Arroyo @ 3.8 DU/Acre	71	DU
RT Tract (Area 3) 23.25 Ac @ 10 DU/Ac	232	DU
	1151	DU

BUILDERS—DEVELOPERS—REALTORS

Builders Owners and Managers of Residential Homes Apartment Properties Shopping Centers Motels
Mobile Home Parks, Free-Standing Commercial Properties
MEMBERS
National Association of Home Builders, International Council of Shopping Centers, National Association of Realtors

Dedication Required

1151 DU X $\frac{170 \text{ Sq. Ft./DU}}{43560 \text{ Sq. Ft./Ac}}$	4.49 Acres
TOTAL USEABLE LAND TO BE DEDICATED	5.43 Acres
Excess Dedication	.94 Acres

We are aware that the excess dedication will not be carried as a credit against future park dedication requirements for other subdivisions. I have been advised by Jim Pond of Kent Nowlin Construction that the North Arroyo Del Pino Channel has been re-excavated to its approximate former condition.

If I can be of any further help to you in this matter, please feel free to contact me at the above listed number.

Very truly yours,

DALE BELLAMAH LAND CO., INC.

Terrance L Connors

Terrance L. Connors
Construction Engineer

TLC/cmc

attach.

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

Bruce —
MS

July 20, 1977

RECEIVED
JUL 22 1977
CITY ENGINEERS

Albuquerque Academy
6400 Wyoming Blvd. N.E.
Albuquerque, New Mexico 87109

Attention: Mr. James Kirkpatrick
Business Manager

Re: Cherry Hills Subdivision

Dear Mr. Kirkpatrick:

Attached is a draft of the agreement for a temporary easement for drainage purposes being requested by A.M.A.F.C.A. and the City of Albuquerque. We would appreciate the review and approval of this document by the Academy at your earliest convenience.

Please note that the easement is temporary in term and flexible in alignment. Further that the flow being conveyed therein is specifically to be conveyed to the existing drainage easement at Rosewood and Harper at the time the south one-half of Harper is paved. Note the provision for the automatic vacation upon the installation of this improvement.

As this is a draft, we would appreciate your acknowledgement as to the proper signatories and notary such that they may be added to the original for submittal and execution.

Should you have any questions or wish to make amendments, please feel free to contact me.

Very truly yours,

GENGE/MURRAY-McCORMICK, INC.

Thomas J. Haack

Thomas J. Haack

TJH:dw

cc: Mortgage Investment Co.
A.M.A.F.C.A.
City of Albuquerque

Genge/Murray-McCormick
2601 Wyoming Blvd., N.E. Suite F
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Thomas J. Hanck

Thomas J. Hanck

TJH:dw

cc: Mortgage Investment Co.
A.M.A.F.C.A.
City of Albuquerque

DRAFT

LETTER OF AGREEMENT FOR DRAINAGE EASEMENT

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It is further understood and agreed that upon the paving of the south portion of the right-of-way of Harper Road N.E., the flows within this easement shall be conveyed by said pavement to the existing twenty foot (20 ft.) drainage easement traversing the lands of the Albuquerque Academy Campus at or near the intersection of Rosewood Road N.E. and Harper Road N.E., and that the easement granted herein shall cease to exist.

DRAFT

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City of Albuquerque
P.O. BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

MAYOR
Harry E. Kinney

CHIEF
ADMINISTRATIVE OFFICER
Frank A. Kleinhenz

July 8, 1977

E20-D5

Mr. Tom Haack
Murray/McCormick Inc.
2601 Wyoming Blvd., N.E.
Albuquerque, NM 87112

Dear Mr. Haack:

The drainage report for Cherry Hills Unit 2 has been reviewed and cannot be accepted in the present form. Below are outlined some guiding concepts that a drainage report must comply with in order to be accepted:

1. Any drainage solution must not interfer with any other property owner rights.

2. The management of the upstream runoff water clearly resides with the developer. (Paragraph A and B of the AMAFCA Resolution)

3. If and where it is necessary to carry the runoff waters from the development to a public drainage facility, crossing properties or easements owned by others, drainage easement must be defined and secured from the owners of such properties or easements.

4. Full attention needs to be paid to the silt carried by the upstream runoff. Provisions must be made for sediment removal in appropriate retention ponds prior to allowing the runoff to enter public streets to prevent traffic hazards. (Section 21B of the subdivision ordinance)

Following these concepts, I cannot acc[illegible] the construction of <u>temporary</u> interceptor channels in Vent[illegible] and Harper Roads because:

A. Such construction would remove the developer's responsibility for the permanent onsite management of the upstream service runoff and transfer this responsibility to public authorities.

B. Such construction would deny access to the properties to the east and to the south.

C. No drainage easements are available to carry the flows to either the Arroyo Del Pino across the Public Service Company easement and the indicated park, or through the land of the Albuquerque Academy Campus land.

Plans, profiles, and cross sections need also to be made available for the channels from the point of origin to the point of termination in a larger drainage facility and not simply terminated at the properties lines (as it is shown for the drainage rundowns). Flow velocities in excess of 3 f.p.s. are highly erosive in bare earth channels and erosion protection facilities must be provided where the velocities exceed the value above.

Very truly yours,

Bruno Conegliano

Bruno Conegliano
Assistant City Engineer-Hydrology

BC/kr

cc - Jim Smith, AMAFCA
V. M. Kimmick, City Engineer
Dwayne Sheppard, Assistant City Engineer-Field
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

May 3, 1977

RECEIVED
MAY 4 1977
CITY ENGINEERS

City of Albuquerque
Department of Public Works
Engineering Division
P. O. Box 1293
Albuquerque, New Mexico 87103

Attention: Mr. V. M. Kimmick, City Engineer

Re: Cherry Hills Subdivision, Unit 2

Gentlemen:

Submitted for your review and approval are two (2) copies of our Comprehensive Drainage Report for the above subdivision.

We wish to bring to your attention a number of features inherent within this study.

- After evaluation of the offsite watersheds draining toward this site, and review of the previously approved study for Cherry Hills Unit 1, it became apparent that the flows at the water block and run-down at Rosewood had been understated.

- As we discussed previously, watershed ridge lines as shown on the prior study have been realigned as agreed. Figure four delineates this modification.

- Although our report indicates the paving of Ventura Street north of Harper Road, this paving will be deferred pending installation of the Tijeras interceptor. The diversion, however, must be installed at the time of development as protection of the eastern perimeter of the project.

It is our client's intention to proceed with this project at the earleist possible date. To this extent the detailed engineering plans are to be submitted shortly and therefore your early review and approval would be appreciated.

Very truly yours,

GENGE/MURRAY-McCORMICK, INC.

Thomas J. Hauck

TJH:dw

cc: Mortgage Investment Co.

CHERRY HILLS, UNIT 2

COMPREHENSIVE DRAINAGE REPORT

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

CHERRY HILLS, UNIT 2

COMPREHENSIVE DRAINAGE STUDY

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SUMMARY OF RESULTS	5
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EXHIBITS

Figure 1	Vicinity & Location Map
Figure 2	Primary Drainage Basin
Figure 3	Developed Drainage Characteristics
Figure 4	Proposed Amendment to Cherry Hills Subdivision May 1974
Figure 5	Typical Lot Drainage

Composite "C" Factor Calculations

Lot Ponding Requirement Calculations

Rational Method Calculations

Bibliography

CHERRY HILLS

COMPREHENSIVE DRAINAGE STUDY

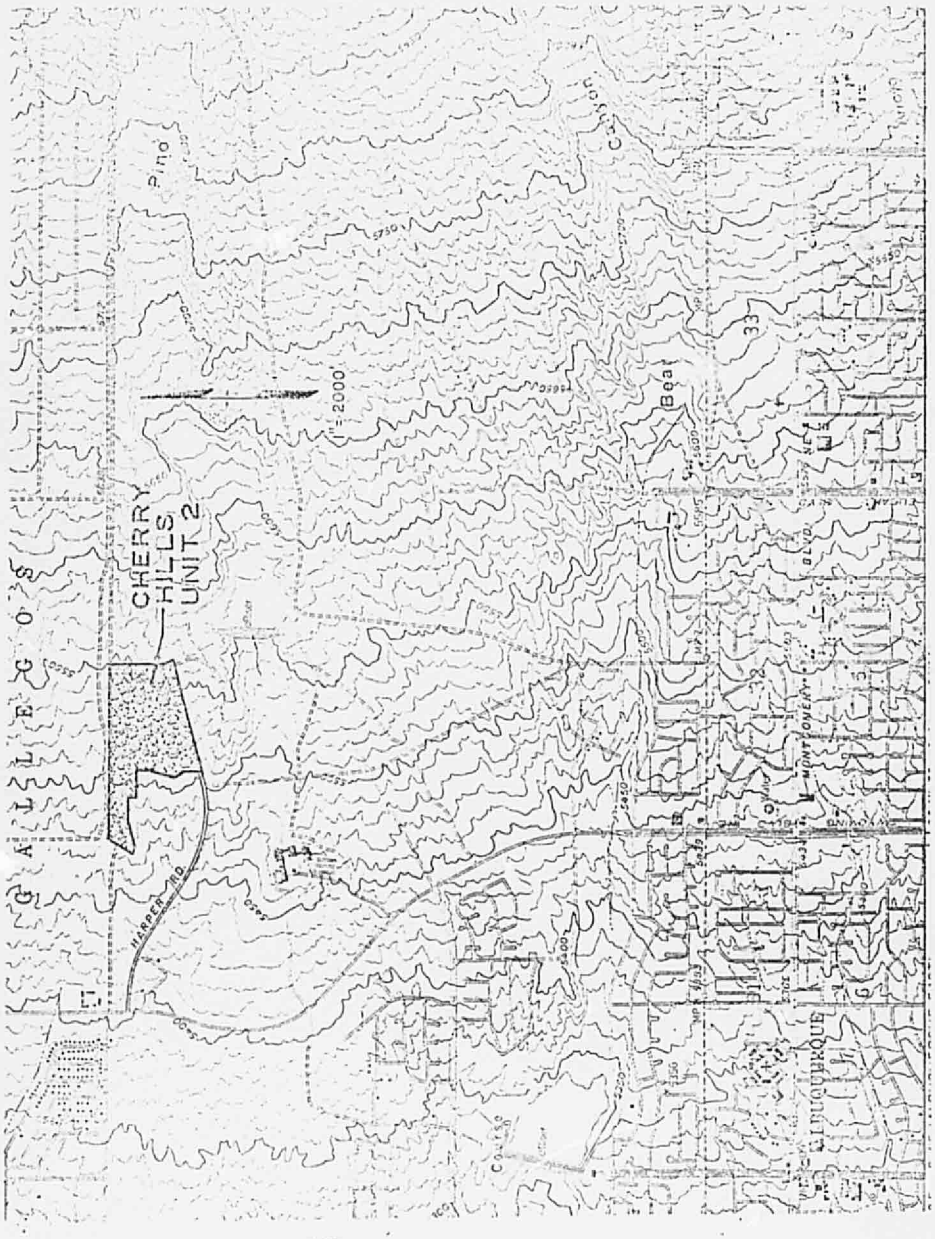
The following report with its supporting calculations and exhibits describes the drainage characteristics affecting the development of Cherry Hills, Unit 2. A number of recommendations regarding the design and implementation of drainage improvements are included within the text to assist the City of Albuquerque, the Albuquerque Metropolitan Flood Control Authority and the developer, Mortgage Investment Company, in the engineering design and implementation of drainage facilities such that urban planning and development can be accomplished with a minimum risk to life and property.

THE SITE

Cherry Hills, Unit No. 2, a proposed R-1 development, is located within the northeast quadrant of the City of Albuquerque, east of Wyoming Boulevard and north of Harper Road. It is bounded on the west by Cherry Hills, Unit 1; on the north by Units 1 and 3 of Heritage Hills, a proposed R-1 development; and on the east and south by unplatted lands.

GENERAL SITE CHARACTERISTICS

The site encompassing 61.4 acres, more or less, slopes from southeast to northwest with an average slope of 3% to 3.5%. The surface soils are predominantly loose sands covered with a light growth of grass. Surrounding land use includes undeveloped land of similar characteristics on the east and south sides and developed residential



VICINITY & LOCATION MAP

MURRAY-McCORMICK, INC.
ENVIRONMENTAL DESIGN
ENGINEERING·PLANNING·SURVEYING

FIG. 1

land on the west. Both Harper Road and Ventura Street on the south and east perimeter are to be improved with this development.

Flow patterns crossing the subdivision include sheet flow and several small arroyos. Off-site flow from the east (unplatted) passes through the site to the North Pino Arroyo.

DESIGN CRITERIA

In analyzing the storm runoff, the Rational Formula, $Q = C \cdot C_f \cdot I \cdot A$, was used. See Urban Storm Drainage, Criteria Manual, Vol. 1, Runoff, Section 3 "Rational Method".

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 concentration (duration) measured in minutes and obtained from Figure IV, Intensity Duration Frequency Curves, Albuquerque Area 1961. (Note: Where a Time of Concentration [Tc] is less than ten minutes from Figure III, the intensity value equal to ten minutes was 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.

ESTIMATED RUNOFF UNDEVELOPED STATE

Drainage within the boundary of the primary drainage basin is in the form of sheet flow with general accumulation into several small arroyos. Offsite drainage from the east passes through the subdivision. 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

Elev. Diff.	Length of Flow	Tc[1].	I100 yr. In./Hr.	C[2].	Area Acres	Q C.F.S.
160'	3,660'	20	4.20	0.38	167.2	277
			Total Undeveloped Runoff			277

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 may 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 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 not exceed the runoff rate from the tract in its natural state.

1. See Appendix; Rational Method Calculations.
2. See Appendix; Composite "C" Computations

For non-ponded runoff, a composite runoff coefficient was developed based upon the percentage of different types of surfaces in the drainage area. The runoff coefficients for various surfaces are as follows:

Streets, Walks and Drives	C = 0.80
Roofs	C = 0.80
Lawns, sandy soils, (Average 2 to 7% slope)	C = 0.12

Table 2

RUNOFF IN DEVELOPED STATE

Area Designation	Acreage A	"C"[3].	Qmax (cfs)	Q100 (cfs)
A-1	4.39	0.68	12.8	
A-2	2.48	0.70	2.5	
A-3	4.60			
A-4	4.13		43.6	43.6
B-1	2.11	0.74	8.1	
B-2	1.29			
B-3	2.07			
B-4	1.89			20.9
C-1	1.83	0.66	6.3	4.9
C-2	0.99	0.65	3.4	2.6
D-1	2.43	0.73	9.1	7.2
O.S. 1	68.56	0.39	126.5	108.3
O.S. 2	43.05	0.43	82.0	75.0
P.S. Co.	9.1	0.38		14.0

3. The runoff coefficient shown is a composite of the percentages of ponded and non-ponded lots - see Appendix.

SUMMARY OF RESULTS

Total Undeveloped Runoff (see Page 3)	277.0 cfs	
Developed Runoff -		
O.S. 1		108.3 cfs
O.S. 2		75.0 cfs
Single Family Area		79.2 cfs
Public Service Co. Easement		14.0 cfs
Total Developed Runoff		276.5 cfs

As shown above, the development of this project including the lot ponding will not increase the storm runoff over that occurring in the natural undeveloped state. Further, offsite flow entering the site on the east perimeter is to be intercepted by and conveyed in Ventura Street to the North Arroyo Del Pino. Those offsite flows from the southeast enter Harper Road and will be transported by the proposed pavement to the dip-diversion to be constructed under the improvement of Cherry Hills, Unit 1 (East) at the intersection with Rosewood Road.

RECOMMENDATIONS

The following recommendations regarding the design and implementation of drainage improvements are included to assist the City of Albuquerque, the Albuquerque Metropolitan Flood Control Authority and the developer in the engineering design and implementation of drainage facilities.

1. Flows within the streets of the development are distributed so that Harper Road and Ventura Street assume the major role in conveying offsite flow. These streets should be graded at not less than 1.0% slope in order to insure adequate carrying capacity.

2. The paving and other surface improvements as shown on Figure 3 should be constructed in accordance with the typical Sections A-A and B-B as shown on Figure 4, therein providing permanent definition of flow patterns for offsite runoff and the temporary transportation of this runoff adjacent to the improvements to be constructed under this development. Figure 4 shows the original street layout and drainage pattern as proposed in 1974 and also shows how those drainage areas relate to the new proposed layout.

3. Runoff from Watershed A (Figure 3) should be conducted to the North Arroyo Del Pino by a 10 ft. wide drainage right-of-way improved in conformance with Section C-C, Figure 4 and an earthen channel traversing the Public Service Company easement designed such that the velocity of flow does not exceed 7.0 feet per second.

4. The ponding areas in each backyard should be 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 to protect any walls which might be constructed. In no case should ponded waters be allowed to stand against a wall or house foundation.

5. Ponds should average 6" deep and the minimum surface area should not be less than 20% of the total area drained into the pond. See Appendix, Lot Ponding Calculations.

SUMMARY

The subject property, by utilizing backyard ponding on single family lots and outlet control in the multi-family and commercial areas, will contribute no more surface runoff to surrounding areas than that which existed before development.

In conclusion, the development of this site should have a beneficial effect on the drainage characteristics of this area, and can be developed safely with no harm to life or property.

Prepared by:

Thomas J. Hack

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

APPENDIX

"RATIONAL METHOD"

COMPOSITE RUNOFF COEFFICIENTS

For the purposes of this report the runoff coefficient (C) and Frequency Factor (C_f) are combined in one factor designated (C). Each of the following determinations of composite runoff coefficients is first computed upon the basis of relative percentages of surface characteristics for the individual areas, and coefficients for 2 to 10 year frequency storms. Each is then multiplied by the Frequency Factor (C_f) of 1.25 for 100 year storms.

UNDEVELOPED LAND

$$C = 0.30^{1.} \times 1.25^{2.} = 0.38$$

DEVELOPED LAND

Typical Lot Area - Cherry Hills, Unit 2

Gross Area		61.5 Ac.
Less: Public Service Co. Easement	9.1 Ac.	
Area in Streets	15.9 Ac.	
Area in Lots		36.5 Ac.
Average Lot Area (189 Lots)		8,412 Sq.Ft.
Typical Lot Width		65 Ft.

1. See Bibliography; Item (1) Table XII
2. See Bibliography; Item (2) Article 3.7

PONDING REQUIREMENTS

Typical Lot Area

Average Lot Area		8,412 S.F.
Less: Front & Side Yards		3,250 S.F.
Area Draining to Pond		5,162 S.F.
Roof Area	25x55	1,375 S.F.
Patio Area		100 S.F.
Lawn Area		3,687 S.F.

Runoff Coefficient

Impervious Area	1,475 S.F.	29% @ 0.80	0.232
Pervious Area	3,687 S.F.	71% @ 0.12	0.085
			0.317

$C \times C_1 = 0.32 \times 1.25 = 0.40$

Pond Volume Requirement

100 year 6-hour precipitation = 2.6 in.

Volume = Runoff coefficient x area x precipitation

V = 0.40 x 5162 x 0.22 = 454 cu.ft.

Depth of Pond 0.50 ft. (6")

Minimum area of pond 780 sq.ft.

Pond area as a percentage of area drained = 18% - use 20%

V = 20% x 5162 sq.ft. x 0.5 ft. = 516 cu.ft.

Ponded Lots - Cherry Hills, Unit 2

C = 0.80

Streets & Walk Area	21x65	1,365 S.F.
Roof Area	25x55	1,375 S.F.
Driveway	30x15	450 S.F.
Total Impervious Area		3,190 S.F.

C = 0.12

Front and Side Yards	3,250 S.F.
Less Roof Area	-1,375 S.F.
Less Driveway	-450 S.F.
Total Pervious Area	1,425 S.F.

Impervious Area	3,190 Sq.Ft.	69% @ 0.80	0.552
Pervious Area	1,425 Sq.Ft.	31% @ 0.12	0.037
Total Area	4,615 Sq.Ft.	100%	0.589

Composite Runoff Coefficient - $C \times C_f$ - $0.59 \times 1.25 = \underline{\underline{0.74}}$

Non-Ponded Lots - Cherry Hills, Unit 2

C = 0.80

Streets & Walk Area	21x65	1,365 S.F.
Roof Area	50x55	2,750 S.F.
Driveway	30x15	450 S.F.
Patio	10x10	100 S.F.
Total Impervious Area		4,665 S.F.

C = 0.12

Total Lot Area	8,412 S.F.
Less Roof Area	-2,750 S.F.
Less Driveway	-450 S.F.
Total Pervious Area	5,212 S.F.

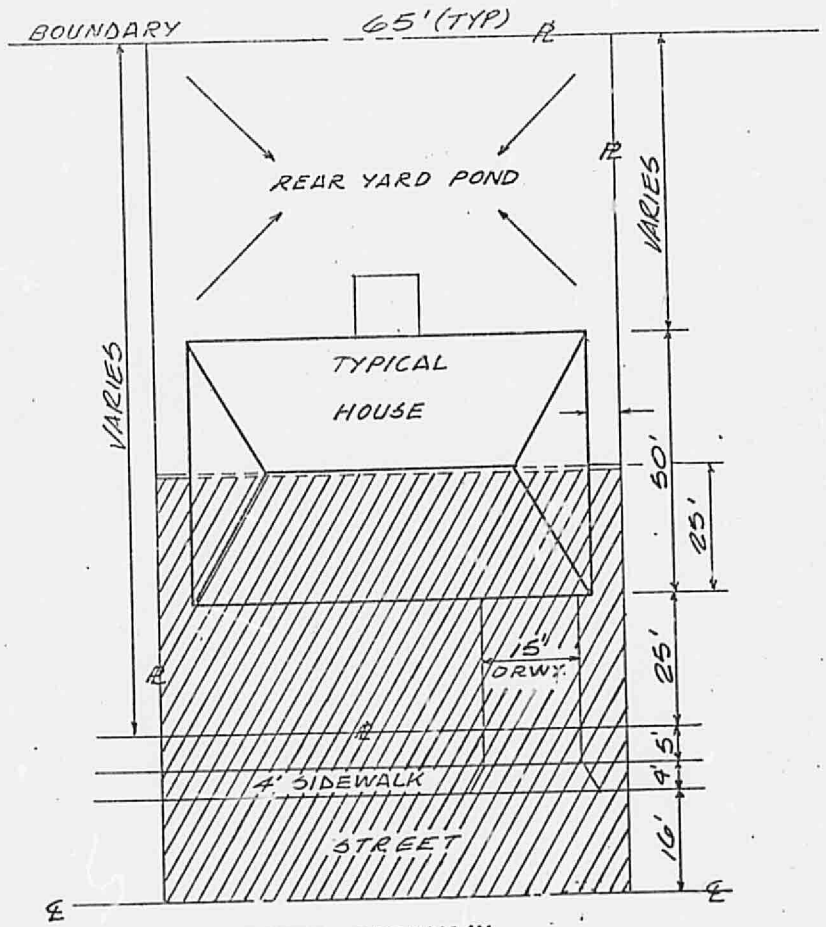
Impervious Area	4665 Sq.Ft.	47% @ 0.80	0.376
Pervious Area	5212 Sq.Ft.	53% @ 0.12	0.064
Total Area	9877 Sq.Ft.	100%	0.440

Composite Runoff Coefficient - $C \times C_f = 0.44 \times 1.25 = 0.55$

Cherry Hills - Unit 1

As the east one-half of Cherry Hills Subdivision Unit 1 is proposed for development without benefit of grading plan and under the approved Drainage Report dated May 1974, a composite runoff coefficient for gross area is herein calculated for use in determining the flow at Harper and Rosewood Roads.

Net Area Draining to Street	3,800 S.F.	45% @ 0.00	0.00
Net Area Draining to Pond	4,600 S.F.	55% @ 0.74	0.41
Gross Area	8,400 S.F.	100%	0.41
			(Use 0.45)



NOTE: REFER APPENDIX FOR CALCULATION

AREA DRAINED TO STREET

FIGURE 5
TYPICAL LOT DRAINAGE

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JOB NO. _____ DATE _____
PROJECT CHERRY HILLS #2
SCALE _____

FIG.G-INTENSITY EXPECTATION FOR ONE-HOUR RAINFALL.*

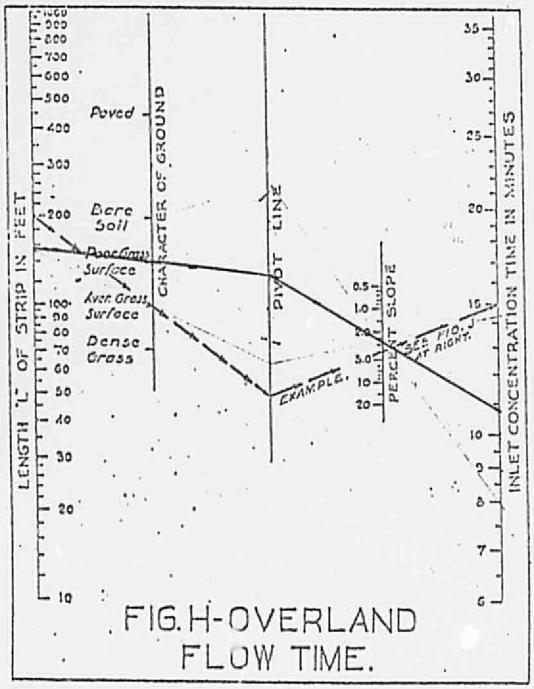

FIG.H-OVERLAND FLOW TIME.

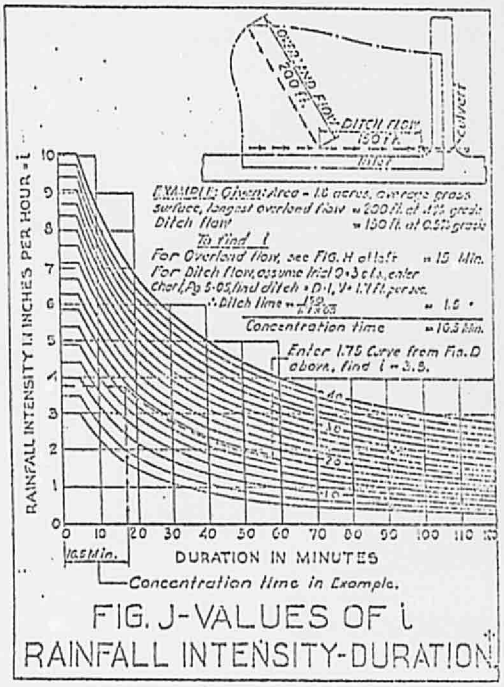

FIG. J-VALUES OF i
RAINFALL INTENSITY-DURATION.†

*Reproduced from Miscellaneous Publication No.204, U.S. Dept. of Agriculture, by David L. Yarnell.
†Adapted from Engineering Manual of the War Department; Part VIII, Chap.1, Dec. '45.

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JOB NO. _____ DATE _____
PROJECT Cheryl Hills - Unit 6
Exhibit "H" SCALE _____

RATIONAL METHOD

RUNOFF COMPUTATIONS

Sheet No. 1

Project: CHERRY HILL SUBD Unit 2

Drainage Area No. A1

Area = 4.39 acres

Maximum Overland Flow: L = 150' S = 2.67%

Maximum Channel Flow:

Channel No. 1 L = 550 S = 0.90%

Channel No. 2 L = 600 S = 3.67%

Channel No. 3 L = S =

Accumulation Time

Overland Flow or Inlet Time: 11 min.

Channel No. 1 Flow:

Velocity = 1.60 ft/sec; Time = ____ / X 60 = 5.7 min.

Channel No. 2 Flow:

Velocity = 4.0 ft/sec; Time = ____ / X 60 = 2.5 min.

Channel No. 3 Flow:

Velocity = ____ ft/sec; Time = ____ / X 60 = ____ min.

Total Accumulation Time: T = 19.2 min.

I = 189/(19.2+26) = 189/44.2 = 4.28

Q_{max} = CIA = (0.68) (4.28) (4.39) = 12.8 c.f.s.

Date: April 5, 1977

Comp. by: [signature]

Checked by:

WEIGHTED RUNOFF COEFFICIENT

24	71	% Ponded	@ 0.74	0.52
10	23	% Non-Ponded	@ 0.55	0.16
—	—	%	@	
34	100	% TOTAL		0.68

RUNOFF COMPUTATIONS

Sheet No. 2

Project: CHERRY HILL Subd Unit 2

Drainage Area No. A2

Area = 2.48 acres

Maximum Overland Flow: L = 150 S = 2.67%

Maximum Channel Flow:

Channel No. 1 L = 610 S = 3.50%

Channel No. 2 L = S =

Channel No. 3 L = S =

Accumulation Time

Overland Flow or Inlet Time: 11 min.

Channel No. 1 Flow:

Velocity = 4.0 ft/sec; Time = ____ / X 60 = 2.5 min.

Channel No. 2 Flow:

Velocity = ____ ft/sec; Time = ____ / X 60 = ____ min.

Channel No. 3 Flow:

Velocity = ____ ft/sec; Time = ____ / X 60 = ____ min.

Total Accumulation Time: T = 13.5 min.

I = 189/(13.5+25) = 189/38.5 = 4.91

Q_{M2-1} = CIA = (0.70) (4.91) (2.48) = 8.5 c.f.s.

Date: April 5, 1977

Comp. by: [illegible]

Checked by:

WEIGHTED RUNOFF COEFFICIENT

12	75 %	Ponded	@ 0.74	0.56
4	25 %	Non-Ponded	@ 0.55	0.14
	%		@	
16	100 %	TOTAL		0.70

RATIONAL METHOD

RUNOFF COMPUTATIONS

Sheet No. 3

Project: CHERRY HILL Subd Unit 2

Drainage Area No. A2+A3

Area = 2.48+4.60 = 7.08 acres

Maximum Overland Flow: L = _____ S = _____

Maximum Channel Flow:

Channel No. 1 L = 730 S = 0.90%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow or Inlet Time: 13.5 min.

Channel No. 1 Flow:

Velocity = 2.5 ft/sec; Time = _____ / X 60 = 4.9 min.

Channel No. 2 Flow:

Velocity = _____ ft/sec; Time = _____ / X 60 = _____ min.

Channel No. 3 Flow:

Velocity = _____ ft/sec; Time = _____ / X 60 = _____ min.

Total Accumulation Time: T = 18.4 min.

I = 189/(18.4+25) = 189/43.4 = 4.35

Q_{100} = CIA = (0.68) (4.35) (7.08) = 20.9 c.f.s.

Date: April 6, 1977

Comp. by: [signature]

Checked by: _____

WEIGHTED RUNOFF COEFFICIENT

24	67 %	Ponded	@ 0.74	0.50
12	33 %	Non-Ponded	@ 0.55	0.18
___	___ %	_____	@ ___	___
36	100 %	TOTAL		0.68

RATIONAL METHOD

RUNOFF COMPUTATIONS

Sheet No. 4

Project: CHERRY HILL Subd Unit 2

Drainage Area No. A1+A2+A3

Area = 4.32+2.46+4.69=11.47 acres

Maximum Overland Flow: L = _____ S = _____

Maximum Channel Flow:

Channel No. 1 L = _____ S = _____

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow or Inlet Time: _____ min.

Channel No. 1 Flow:

Velocity = _____ ft/sec; Time = _____ / X 60 = _____ min.

Channel No. 2 Flow:

Velocity = _____ ft/sec; Time = _____ / X 60 = _____ min.

Channel No. 3 Flow:

Velocity = _____ ft/sec; Time = _____ / X 60 = _____ min.

Total Accumulation Time: T = 19.2 min.

I = _____ = _____ = _____

Q_{100} = CIA = (0.68) (4.28) (11.47) = 33.1 c.f.s.

Date: April 5, 1977

Comp. by: [signature]

Checked by: _____

WEIGHTED RUNOFF COEFFICIENT

47.67 % Ponded @ 0.74 0.50

23.33 % Non-Ponded @ 0.55 0.18

___ % _____ @ _____

100 % TOTAL 0.68

RATIONAL METHOD

RUNOFF COMPUTATIONS

Sheet No. 5

Project: CHERRY HILL Subd Unit 2

Drainage Area No. A1+A2+A3+A4

Area = 11.47+4.13 = 15.6 acres

Maximum Overland Flow: L = _____ S = _____

Maximum Channel Flow:

Channel No. 1 L = 680 S = 2.50%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow or Inlet Time: 19.2 min.

Channel No. 1 Flow:

Velocity = 4.6 ft/sec; Time = _____ / X 60 = 2.5 min.

Channel No. 2 Flow:

Velocity = _____ ft/sec; Time = _____ / X 60 = _____ min.

Channel No. 3 Flow:

Velocity = _____ ft/sec; Time = _____ / X 60 = _____ min.

Total Accumulation Time: T = 21.7 min.

I = 189/(21.7+25) = 189/46.7 = 4.05

Q_{max} = CIA = (0.69) (4.05) (15.6) = 43.6 c.f.s. = Q100

Date: April 5, 1977

Comp. by: [signature]

Checked by: _____

WEIGHTED RUNOFF COEFFICIENT

75 73 % Ponded @ 0.74 0.54

28 27 % Non-Ponded @ 0.55 0.15

___ % _____ @ ___ ___

100 % TOTAL 0.69

FIG. G-INTENSITY EXPECTATION FOR ONE-HOUR RAINFALL.

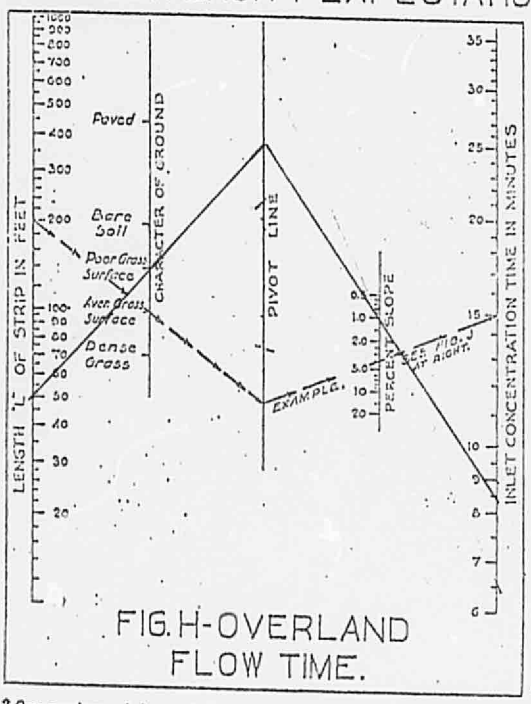

FIG. H-OVERLAND FLOW TIME.

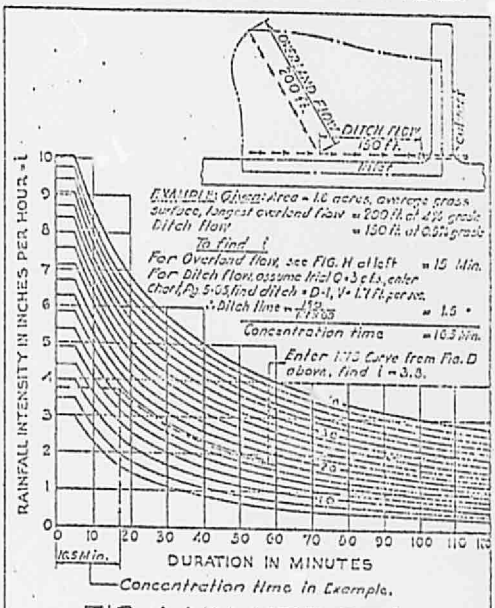

FIG. J-VALUES OF i
RAINFALL INTENSITY-DURATION.

*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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PROJECT Cherry Hills - Unit 2
SCALE _____

RATIONAL METHOD

RUNOFF COMPUTATIONS

Sheet No. 6

Project: CHERRY HILL SUBD Unit 2

Drainage Area No. B1

Area = 2.11 acres

Maximum Overland Flow: L = 50 S = 1.00%

Maximum Channel Flow:

Channel No. 1 L = 670 S = 3.40%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow or Inlet Time: 8.6 min.

Channel No. 1 Flow:

Velocity = 4.0 ft/sec; Time = _____ / X 60 = 2.8 min.

Channel No. 2 Flow:

Velocity = _____ ft/sec; Time = _____ / X 60 = _____ min.

Channel No. 3 Flow:

Velocity = _____ ft/sec; Time = _____ / X 60 = _____ min.

Total Accumulation Time: T = 11.4 min.

I = 189/(11.4+25) = 189/36.4 = 5.19

Q_{max} = CIA = (0.74) (5.19) (2.11) = 8.10 c.f.s.

Date: April 5, 1977

Comp. by: [signature]

Checked by: _____

WEIGHTED RUNOFF COEFFICIENT

20 100 % Ponded @ 0.74 0.74

___ % Non-Ponded @ ___ ___

___ % _____ @ ___ ___

20 100 % TOTAL ___

RATIONAL METHOD

RUNOFF COMPUTATIONS

Sheet No. 7

Project: CHERRY HILL Sub^n Unit 2

Drainage Area No. B1 + B2 + B3

Area = 2.44 + 1.22 + 2.07 = 5.47 acres

Maximum Overland Flow: L = _____ S = _____

Maximum Channel Flow:

Channel No. 1 L = 400 S = 1.00%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow or Inlet Time: 11.4 min.

Channel No. 1 Flow:

Velocity = 3.0 ft/sec; Time = _____ / X 60 = 2.2 min.

Channel No. 2 Flow:

Velocity = _____ ft/sec; Time = _____ / X 60 = _____ min.

Channel No. 3 Flow:

Velocity = _____ ft/sec; Time = _____ / X 60 = _____ min.

Total Accumulation Time: T = 13.6 min.

I = 189/(13.6+25) = 189/38.6 = 4.90

Q = CIA = (0.71) (4.90) (5.47) = 19.0 c.f.s.

Date: April 1977

Comp. by: [signature]

Checked by: _____

WEIGHTED RUNOFF COEFFICIENT

35 85 % Ponded @ 0.74 0.63

6 15 % Non-Ponded @ 0.55 0.08

___ % _____ @ ___ ___

100 % TOTAL 0.71

RUNOFF COMPUTATIONS

Sheet No. 8

Project: CHERRY HILL Subd Unit 2

Drainage Area No. B1+B2+B3+B4

Area = 5.47+1.89=7.36 acres

Maximum Overland Flow: L = _____ S = _____

Maximum Channel Flow:

Channel No. 1 L = 200' S = 1.00%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow or Inlet Time: 13.6 min.

Channel No. 1 Flow:

Velocity = 3.1 ft/sec; Time = _____ / X 60 = 1.1 min.

Channel No. 2 Flow:

Velocity = _____ ft/sec; Time = _____ / X 60 = _____ min.

Channel No. 3 Flow:

Velocity = _____ ft/sec; Time = _____ / X 60 = _____ min.

Total Accumulation Time: T = 14.7 min.

I = 189/(14.7+25) = 189/39.7 = 4.76

Q = CIA = (0.70) (4.76) (7.36) = 24.5 c.f.s.

Q_{100} = C.I.A. = (0.70) (4.05) (7.36) = 20.9

Date: April 5, 1977

WEIGHTED RUNOFF COEFFICIENT

Comp. by: [signature]

Checked by: _____

41	80 %	Ponded	@ 0.74	0.59
10	20 %	Non-Ponded	@ 0.55	0.11
	%		@	
51	100 %	TOTAL		0.70

RATIONAL METHOD

RUNOFF COMPUTATIONS

Sheet No. 9

Project: CHERRY HILL Sub^n Unit 2

Drainage Area No. C1

Area = 1.83 acres

Maximum Overland Flow: L = 50' S = 1.00%

Maximum Channel Flow:

Channel No. 1 L = 250' S = 0.50%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow or Inlet Time: 8.6 min.

Channel No. 1 Flow:

Velocity = 1.5 ft/sec; Time = _____ / X 60 = 2.8 min.

Channel No. 2 Flow:

Velocity = _____ ft/sec; Time = _____ / X 60 = _____ min.

Channel No. 3 Flow:

Velocity = _____ ft/sec; Time = _____ / X 60 = _____ min.

Total Accumulation Time: T = 11.4 min.

I = 189/(11.4+25) = 189/36.4 = 5.19

Q_{max} = CIA = (0.66) (5.19) (1.83) = 6.3 c.f.s.

Q_{100} = CIA = (0.66) (4.05) (1.83) = 4.9

Date: April 5, 1977

Comp. by: [signature]

Checked by: _____

WEIGHTED RUNOFF COEFFICIENT

6	55	% Ponded	@ 0.74	0.41
5	45	% Non-Ponded	@ 0.55	0.25
		%	@	
11	100	%	TOTAL	0.66

RATIONAL METHOD

RUNOFF COMPUTATIONS

Sheet No. 10

Project: CHERRY HILL Subd Unit 2

Drainage Area No. C2

Area = 0.99 acres

Maximum Overland Flow: L = 50' S = 1.00%

Maximum Channel Flow:

Channel No. 1 L = 200' S = 3.00%

Channel No. 2 L = 100' S = 1.00%

Channel No. 3 L = S =

Accumulation Time

Overland Flow or Inlet Time: 8.6 min.

Channel No. 1 Flow:

Velocity = 3.0 ft/sec; Time = ___ / X 60 = 1.1 min.

Channel No. 2 Flow:

Velocity = 2.0 ft/sec; Time = ___ / X 60 = 0.8 min.

Channel No. 3 Flow:

Velocity = ___ ft/sec; Time = ___ / X 60 = ___ min.

Total Accumulation Time: T = 10.5 min.

I = 189/(10.5+25) = 189/35.5 = 5.32

Q_{max} = CIA = (0.65) (5.32) (0.99) = ___ c.f.s.

Q_{100} = C.I.A. = (0.65)(4.05)(0.99) 2.6

Date: April 1977

WEIGHTED RUNOFF COEFFICIENT

Comp. by: [signature]

Checked by:

2	50 %	Ponded	@ 0.74	0.37
2	50 %	Non-Ponded	@ 0.55	0.28
	___ %		@	
4	100 %	TOTAL		0.65

RATIONAL METHOD

RUNOFF COMPUTATIONS

Sheet No. _____

Project: CHERRY HILL Subd. Unit 2

Drainage Area No. D1

Area = 2.43 _____ acres

Maximum Overland Flow: L = 50' S = 1.00%

Maximum Channel Flow:

Channel No. 1 L = _____ S = _____

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow or Inlet Time: 8.6 min.

Channel No. 1 Flow:

Velocity = 4.0 ft/sec; Time = _____ / X 60 = 3.1 min.

Channel No. 2 Flow:

Velocity = _____ ft/sec; Time = _____ / X 60 = _____ min.

Channel No. 3 Flow:

Velocity = _____ ft/sec; Time = _____ / X 60 = _____ min.

Total Accumulation Time: T = 11.7 min.

I = 189/(11.7+25) = 189/36.7 = 5.15

Q = CIA = (0.73) (5.15) (2.43) = 9.1 c.f.s.

Q_{100} = C.I.A. = (0.73) (4.05) (2.43) = 7.2

Date: April 5, 1977

Comp. by: [signature]

Checked by: _____

WEIGHTED RUNOFF COEFFICIENT

18	95 %	Ponded	@ 0.74	0.70
1	5 %	Non-Ponded	@ 0.55	0.03
	%		@	
19	100 %	TOTAL		0.73

CHERRY HILLS UNIT 2.

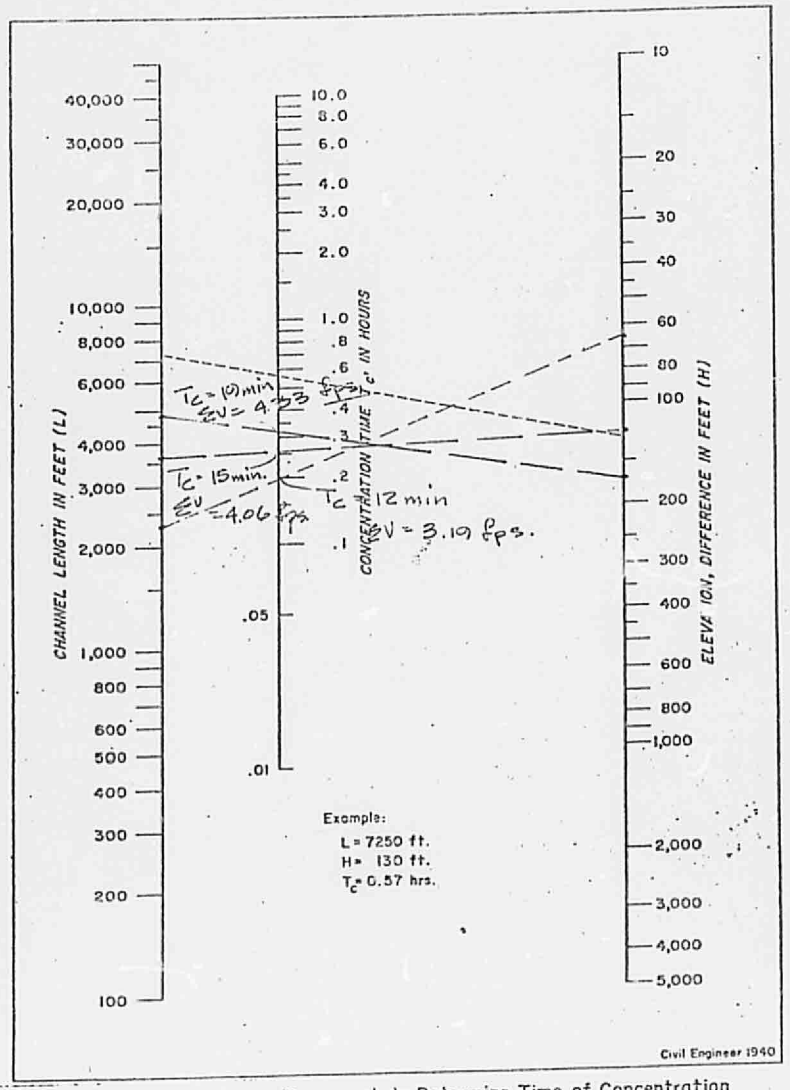

Figure 2-2 --- Nomograph to Determine Time of Concentration

RATIONAL METHOD

RUNOFF COMPUTATIONS

Sheet No. 12

Project: Cherry Hills Sub.-Unit 2

Drainage Area No. C.S. 1

Area = 68.56 acres

Maximum Overland Flow: L = _____ S = _____

Maximum Channel Flow:

Channel No. 1 L = _____ S = _____

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow or Inlet Time: _____ min.

Channel No. 1 Flow:

Velocity = _____ ft/sec; Time = _____ / X 60 = _____ min.

Channel No. 2 Flow:

Velocity = _____ ft/sec; Time = _____ / X 60 = _____ min.

Channel No. 3 Flow:

Velocity = _____ ft/sec; Time = _____ / X 60 = _____ min.

Total Accumulation Time: *T = 15 min.

I = 189(1.5+25) = 739/40 = 4.73

Q = CIA = (0.39) (4.73) (68.56) = 126.5 c.f.s.

Q100 = (0.39)(4.05)(68.56) = 108.3

Date: April 5, 1977

Comp. by: [signature]

Checked by: _____

WEIGHTED RUNOFF COEFFICIENT

___ % Ponded @ ___ ___

98 % Non-Ponded @ 0.38 0.37

2 % Streets @ 1.00 0.02

100 % TOTAL 0.39

RATIONAL METHOD

RUNOFF COMPUTATIONS

Sheet No. 13

Project: CHERRY HILL SUB'D Unit 2

Drainage Area No. _____

Area = _____ acres

Maximum Overland Flow: L = _____ S = _____

Maximum Channel Flow:

Channel No. 1 L = 1890 S = 3.00%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow or Inlet Time: 12 min.

Channel No. 1 Flow:

Velocity = 5.5 ft/sec; Time = _____ / X 60 = 5.7 min.

Channel No. 2 Flow:

Velocity = _____ ft/sec; Time = _____ / X 60 = _____ min.

Channel No. 3 Flow:

Velocity = _____ ft/sec; Time = _____ / X 60 = _____ min.

Total Accumulation Time: T = 17.7 min.

I = 189/(17.7+25) = 189/42.7 = 4.43

Q = CIA = (0.43) (4.43) (43.05) = 82.0 c.f.s.

Q_{100} = C.I.A. = (0.43) (4.05) (43.05) = 75.0

Date: April 5, 1977

Comp. by: [signature]

Checked by: _____

WEIGHTED RUNOFF COEFFICIENT

___ %	Ponded	@ ___	___
91 %	~~Non-Ponded~~ undeveloped.	@ 0.38	0.34
9 %	STREETS	@ 1.00	0.09
100 %	TOTAL		0.43

RATIONAL METHOD

RUNOFF COMPUTATIONS

Sheet No. 14

Project: Cherry Hills Subd Unit 2.

Drainage Area No. Area to Harper-Rosewood Diversion

Area = 99.85 acres

Maximum Overland Flow: L = 1650 S = 3.00%

Maximum Channel Flow:

Channel No. 1 L = _____ S = _____

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow or Inlet Time: 17.7 min.

Channel No. 1 Flow:

Velocity = 7.5 ft/sec; Time = _____ / X 60 = 3.2 min.

Channel No. 2 Flow:

Velocity = _____ ft/sec; Time = _____ / X 60 = _____ min.

Channel No. 3 Flow:

Velocity = _____ ft/sec; Time = _____ / X 60 = _____ min.

Total Accumulation Time: T = 21.4 min.

I = 189 (21.4+25) = 189/46.4 = 4.07

Q = CIA = (0.45) (4.07) (99.85) = 182.9 c.f.s.

Date: _____

Comp. by: _____

Checked by: _____

WEIGHTED RUNOFF COEFFICIENT

___ % Ponded @ ___ ___

___ % Non-Ponded @ ___ ___

___ % _____ @ ___ ___

100 % TOTAL ___

RATIONAL METHOD

RUNOFF COMPUTATIONS

Sheet No. 15

Project: Cherry Hills Sub^n - Unit 2

Drainage Area No. Harper/Rosewood Intersection

Area = 103.11 acres

Maximum Overland Flow: L = _____ S = _____

Maximum Channel Flow:

Channel No. 1 L = _____ S = _____

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow or Inlet Time: 17.7 min.

Channel No. 1 Flow:

Velocity = 7.5 ft/sec; Time = _____ / X 60 = 3.7 min.

Channel No. 2 Flow:

Velocity = _____ ft/sec; Time = _____ / X 60 = _____ min.

Channel No. 3 Flow:

Velocity = _____ ft/sec; Time = _____ / X 60 = _____ min.

Total Accumulation Time: T = 21.4 min.

I = 189/(21.4+25) = 189/46.4 = 4.07

Q = CIA = (0.45) (4.07) (103.11) = 188.8 c.f.s.

Date: _____

Comp. by: _____

Checked by: _____

WEIGHTED RUNOFF COEFFICIENT

___ % Ponded @ ___ ___

___ % Non-Ponded @ ___ ___

___ % _____ @ ___ ___

100 % TOTAL ___

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