HYDROLOGY E20/D2 1 of 2 8 PLANS

E20/D2

8 Plans

CHAMBERS • CAMPBELL • ISAACSON • CHAPLIN, INC.
3500 INDIAN SCHOOL RD., N.E. / ALBUQUERQUE, NEW MEXICO 87106 / PHONE (505) 266-5521

May 21, 1976

Mr. Kleston Laws
City Engineer's Office
City of Albuquerque
P.O. Box 1293
Albuquerque, NM 87103

RECEIVED
MAY 24 1976
CITY ENGINEERS

REFERENCE: Academy Hills - Master Drainage Report

Dear Mr. Laws:

We are enclosing two (2) copies of the revised drainage report for the Academy Hills Properties. The revisions you requested have been made, and we hope the plan meets with your approval.

Specifically, the developer wishes to proceed with Units 2 and 3 (areas 5 and 7 of the report) as quickly as possible. In order to avoid the financial difficulties involved with the Bear Tributary-Eubank crossing, Eubank Boulevard will not be included in the plat of Unit 3 at this time. In addition, any temporary drainage structures required adjacent to Unit 2 within the Academy Road right-of-way will be included in the design plans for that Unit. The best information we have received to date indicates that a half section of pavement will most likely be required for Academy Road adjacent to Unit 2. If this is the case, the drainage scheme will work as shown in the report. Otherwise, temporary structures will be provided until Academy is paved.

Please contact me at your earliest convenience should you feel further discussion is necessary.

Very truly yours,

Kent M. Whitman

Kent M. Whitman
Engineering Dept.

KMW:dd
Enclosures

cc: Mr. Dick Bock
Mr. Charles Haegelin

CHAMBERS • CAMPBELL • ISAACSON • CHAPLIN, INC.
3500 INDIAN SCHOOL RD., N.E. / ALBUQUERQUE, NEW MEXICO 87106 / PHONE (505) 266-5521

February 27, 1976

Mr. Kleston Laws
City Engineer's Office
P.O. Box 1293
Albuquerque, New Mexico 87103

REFERENCE: Academy Hills Unit 1, North Boundary Diversion Channel

Dear Mr. Laws:

Based on a field acquired profile of the subject diversion channel, we have found it desirable to make some minor grade changes to the original design. Please place the enclosed revised plan in your files for your reference. We are also forwarding a copy to Kent Nowlin Construction Company.

I hope you will find these revisions acceptable.

Sincerely yours,

Kent M. Whitman

Kent Whitman, for
CHAMBERS, CAMPBELL,
ISAACSON, CHAPLIN, INC.

KW/slf

sepras signed March 76

Kles Laws

CHAMBERS • CAMPBELL • ISAACSON • CHAPLIN, INC.
3500 INDIAN SCHOOL RD., N.E. / ALBUQUERQUE, NEW MEXICO 87106 / PHONE (505) 266-5521

February 24, 1976

Duane Shepherd
Assistant City Engineer
City of Albuquerque

Dear Duane:

This letter will commit Amdec and Home Planning to accomplish the following requirements you have made for final approval of grading plans in Academy Hills Unit #1:

1. Maintain dip section across Layton Avenue at a point 55' East of the easterly boundary of Academy Hills #1.

2. If a permanent solution to the handling of the waters carried by the above dip section has not been found by the time Layton Avenue is ready to be paved, we will apply temporary paving to the dip section.

3. Build a temporary diversion dam on the arroyo entering the subdivision from the east approximately 700' north of the southwest corner of the subdivision. This dam is intended to divert water from said arroyo into an existing diversion ditch.

4. Build a temporary diversion ditch and channel along the north side of the subdivision to protect the subdivision from the adjacent arroyo.

I trust this letter fulfills your requirements.

Very truly yours,

Thomas O. Isaacson

Thomas O. Isaacson,
Vice President

TOI/pld

Agreed To:

Affiliated Mortgage & Development Co.

By Charles A. Haegelin
Charles A. Haegelin
Vice President

CHAMBERS • CAMPBELL • ISAACSON • CHAPLIN, INC.
3500 INDIAN SCHOOL RD., N.E. / ALBUQUERQUE, NEW MEXICO 87106 / PHONE (505) 266-5521

RECEIVED
DEC 1 6 1975
CITY ENGINEERS

December 17, 1975

Mr. Q.R. Kielich
Assistant City Engineer
City of Albuquerque
P.O. Box 1293
Albuquerque, New Mexico 87103

RE: Academy Hills Subdivision, Unit #1

Dear Mr. Kielich:

Enclosed please fine two prints of the arroyo diversion plan for the east boundary of Academy Hills Subdivision, Unit #1, as per your request.

Very truly yours,

Tom Isaacson

Thomas O. Isaacson
Vice President

TOI:df

Enclosures

cc: Mr. Dick Bock
File #500A

Kles: 18 Dec 75

This is a drawing of the temporary dike along the east side of Academy Hills Unit 1 until development of the lands to the east.

ADDENDUM NO. 1

ACADEMY HILLS SUBDIVISION UNIT #1
DRAINAGE REPORT

January 17, 1975

On January 16, 1975, a meeting was held at AMAFCA to discuss the Academy Hills Drainage Report. Present at the meeting were representatives from the City Engineer's Office, Home Planning Development Company, the Albuquerque Board of Education, AMDEC, and CCIC.

The meeting concerned itself with the problem of offsite flows from Area X and Area Y intercepting the site. AMAFCA proposed an alternative to the solutions provided by this report. In particular, it was suggested that two temporary north-south interceptor dike-ditches be constructed to divert the majority of flows from Area X and Y directly to the south into the Bear Canyon Tributary. (See accompanying plat.) The first interception would divert the majority of flows from Area X, and to a lesser degree, flows from Area Y. These interceptor ditches would be temporary in that future development of the area to the east of the site would incorporate north-south street design to handle these flows.

The remaining runoff from Area X not affected by the interceptor ditch would be allowed to continue to the west. When development in and around Layton Avenue and Academy Road takes place, these flows will then be intercepted by a north-south street system. This will direct the runoff to the north to Academy Road and into the Pino Water Basin.

The principle of handling these flows was agreed upon by all parties present. AMAFCA and the City Engineer stated their approval of the Academy Hills Subdivision Unit #1 subject to this addendum.

Thomas O. Isaacson

/s/ Thomas O. Isaacson
Chief Engineer, for
CHAMBERS, CAMPBELL, ISAACSON
AND CHAPLIN, INC.

JERRY D.

home planning development co.

142 meadow lane
white rock
los alamos, n. m. 87544
phone 505-672-3811

4201 carlisle, n.e.
albuquerque, n. m. 87107
phone 505-296-5451

September 12, 1974

The Honorable Harry Kinney
Mayor of the City of Albuquerque
P. O. Box 1293
Albuquerque, NM 87103

Dear Sir:

In February 1973 several of the major land developers in the Northeast Heights requested the city to provide services to this area (Attach. #1). On March 5, 1973, the city manager concurred with our proposals (Attach. #2).

Since that time several major improvements have been accomplished, i.e., two major water trunk lines with the associated equipment, have been built in Morris and Juan Tabo north of Montgomery Blvd. AMAFCA is working on an overall drainage plan, and most of the major streets are in assessment districts.

However, little or no progress has been made to provide sanitary sewer services to this area, and we have been informed that no more building permits will be issued due to unavailability of sanitary sewers. It is most negligent on the part of the city to ignore this essential service, for several hundred thousands of dollars of potential taxes could be collected immediately; plus the money already spent by the city for these other services is not being utilized.

We have requested that the engineering department come up with a sanitary sewer design to be placed in Academy Road from Academy Hills Subdivision to Wyoming Boulevard to serve this area (Academy Road is in an assessment district). To our knowledge, no studies or work has been done, but the standard phrase is, "Wait for the Tijeras #5 interceptor line." We all know this is at least five years in the future and we cannot afford to wait until then.

Your immediate attention to this problem is requested. I feel the

scarcity of residential lots and the rapid escalating of prices is important enough to merit your personal attention. Please call me is you have any questions.

Sincerely,

HOME PLANNING DEVELOPMENT CO.

Ed Leslie
President

Attachs.

February 20, 1973

City of Albuquerque
Environmental Planning Commission
Albuquerque, New Mexico

Gentlemen:

The undersigned developers are proposing to you that land between the Pino Arroyo and Bear Canyon, known as Elena Gallegos Grant, (see attached map), be annexed to the City, provided that services are furnished to the area.

There have been numerous problems encountered by individual developers in the past, i.e., sewer and water line extensions and capacities, drainage flow, street improvements, etc. To facilitate orderly planning and assure continuity of land development, the undersigned developers believe that these problems can be best solved by a common effort on their part and on the part of the City. Listed below are some of our proposals:

1. An overall drainage plan be developed under the guidance of AMAFCA and the City Engineer.

2. Major streets (Wyoming, Academy, Eubank, Juan Tabo, Spain and others) be placed in a paving district.

3. Sewer and water trunks be extended as necessary, under whatever fiscal policy is adopted. (These trunks can be included in a utility and paving district.)

This joint action by us, the developers and the City, will benefit not only the developer, but aid the taxpayers by utilizing existing major water and sewage trunk facilities. Some additional expense will be required, but expenditures per development site will be minimized. However, the orderly progress of

atch #1

developing this land will benefit most of all the future homeowner.

Very truly yours,

Roger Cox

Joe Fuller

Ed Leslie

Gary Swearingen

cc:

City Manager
Public Works Department
Parks Department
Fire Department
Police Department
AMAFCA

City of Albuquerque

BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

CITY COMMISSION: Louis E. Saavedra, Chairman • Nancy D. Koch, Vice-Chairman
Harry E. Kinney, Commissioner • Robert C. Poole, Commissioner
Ray R. Baca, Commissioner
CITY MANAGER: Herbert H. Smith
City Hall, 400 Marquette, NW

March 5, 1973

Mr. Frank L. Hines
Home Planning Development Co.
4201 Carlisle Blvd., N.E.
Albuquerque, New Mexico 87107

Dear Mr. Hines:

May I express my appreciation to you for your communication of several days ago, together with the attached material regarding the proposal for the development of a section of the Northeast Heights. I had already been informed about your proposal by Mr. Vern Hagen, Director of our Planning Department and have indicated to him the fact that I am pleased to see that some of our developers are interested in submitting constructive and positive suggestions to us. Naturally, I will rely on Mr. Hagen and the Planning Department as well as the Environmental Planning Commission to act on your suggestion and to make any recommendations which they feel desirable to the City Manager's Office and the City Commission.

I am sure that Mr. Hagen will be in direct contact with you regarding this matter, and once again, may I express my personal appreciation to you for including me in the distribution list of your material.

Sincerely yours,

Herbert H. Smith
City Manager

HHS:sg
ICM07188

cc: R. Vaughn, Chmn., EPC
V. Hagen, Director, Planning
E. Hensch, Director, Public Works
Circ/CM

atch #2

City of Albuquerque

BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

CITY COMMISSION: Harry E. Kinney, Chairman • Ray R. Baca, Vice-Chairman
Louis E. Saavedra, Commissioner • Nancy D. Koch, Commissioner
Robert C. Poole, Commissioner
CITY MANAGER: [redacted] Herbert H. Smith
City Hall, 400 Marquette, NW

RECEIVED
AUG 16 1973
CITY ENGINEERS

August 13, 1973

Mr. Frank L. Hines
Home Planning Development Co.
4201 Carlisle N.E.
Albuquerque, New Mexico

SUBJECT: Academy Hills Subdivision - Unit One
(AX-72-47, S-72-56, Z-72-194)

Dear Frank,

In order to clarify our files on this plat, it is necessary that you agree to submit a drainage study on Academy Hills Subdivision - Unit One, before any development can take place. I would appreciate it if you could sign this letter indicating your agreement.

Sincerely,

V. M. Kinnick
City Engineer

Bob — file with drainage report. Make file for it. Jim

Frank L. Hines
Frank L. Hines

VMK:ev

[illegible]

ACADEMY HILLS MASTERPLAN

PROJECT SUMMARY

The Academy Hills planned unit development is a 196 acre parcel of land located in the far northwest heights of the Albuquerque metropolitan area. It will be bounded by Academy extended on the north, Eubank Boulevard on the east, and Layton Avenue (between its intersections with Eubank and Academy) on the south and west.

The masterplan for Academy Hills is traditional in the sense that it incorporates traditional uses of land and emulates good land use treatments found here in our own Albuquerque metropolitan area -- good treatments in land use mix, in open space, in internal and external transportation systems and good design treatment for internal and external drainage systems.

The masterplan represents uniqueness and innovation in its attempts to improve on land use details of subdivision design and its preplanned linkage relationships to public plans for open space areas and recreation corridors and public school location factors. Approximately 11% of the development is open space designed to provide pedestrian movement corridors to and from school and to and from active and passive recreation centers. Another 5% of the subdivision is school property. The attached table summarizes the land use and density analysis of the Academy Hills Masterplan.

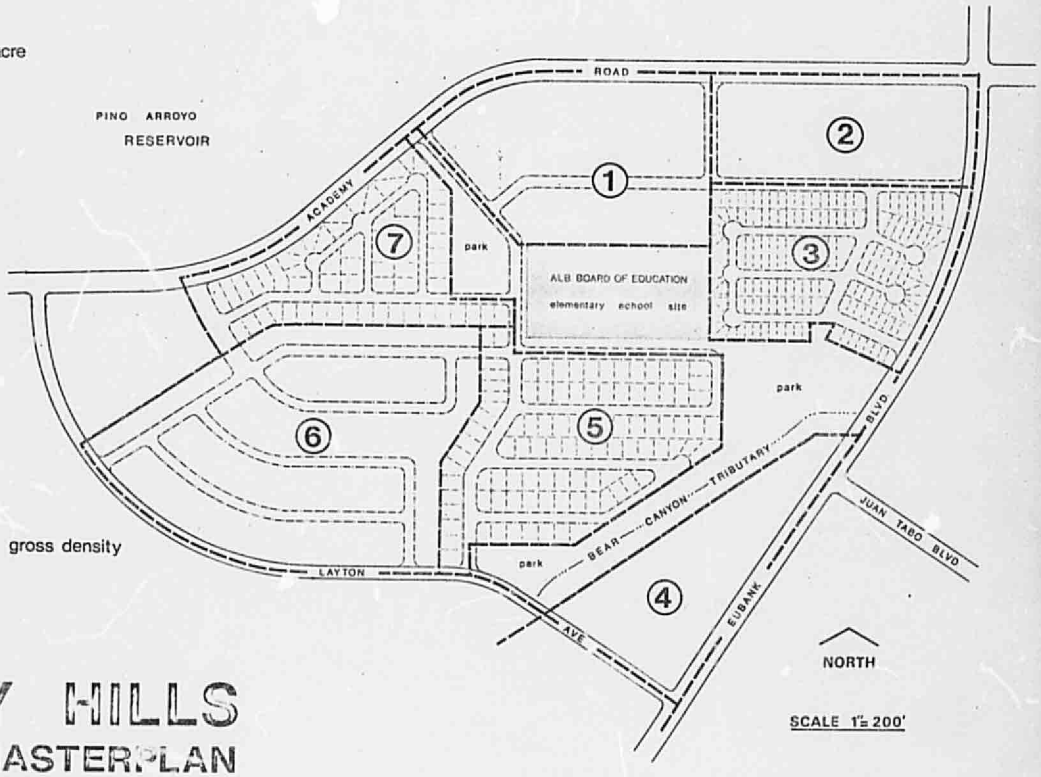
Volume of land use by type and mix is not the only important feature of the Academy Hills Masterplan. What is also important is the design treatment

for the Edges created by adjoining land uses within the development. A careful examination of the subdivision reveals little, if any potential friction at the Edges of land uses which together comprise the development. A few of these critical Edges and their design considerations merit mention here:

1. The Edge between major arterial streets and adjacent land use:
   a. Single family lots do not front on any major arterial streets. Access points of subordinate streets are limited and controlled by this design feature.
   b. The masterplan eliminates the traditional use of strip commercial land. Although the subdivision offers 7,500 lineal feet of potential strip commercial frontage, only 1,700 lineal feet of commercial frontage is used. This limited frontage results by capitulizing urban land use at the intersection of Academy and Eubank Boulevard for regional and neighborhood commercial and business park development.
2. The Edge between single family detached land use and other land uses:
   a. Strong design elements buffer single family detached areas from other land uses within the development. A multi-purpose linkage system comprising open space, parks, pedestrian and bicycle corridors, and grassed drainage ways, provides a unique edge between single family detached land use and other land use elements of the subdivision. This multi-purpose linkage system provides design details which will improve both urban form and urban environment. Its implementation will require doing things somewhat differently than in the past -- different value judgments for both the public as well as the private sector.

There are, of course, other important design features within the Academy Hills Masterplan and these all will be carefully discussed in presentations and staff reviews over the next several weeks. Your input regarding the plan is encouraged. A general project information sheet providing names of Developer contacts is attached for your convenience.

tract	zone	d.u's	acres	d.u's/acre
1	R-2	230	24	9.6
2	C-1	-	17	-
3	SU-1	166	22	7.5
4	R-3	300	17	17.6
5	R-1	99	25	3.9
6	R-1	144	40	3.6
7	R-1	63	19	3.3
	SCHOOL	-	10	-
	OPEN	-	22	-
		1,002	196	= 5.1 gross density



ACADEMY HILLS
PROPOSED MASTERPLAN

home planning development co.
affiliated mortgage & devel. co.

CCIC

ACADEMY HILLS

LAND USE AND DENSITY ANALYSIS

LAND USE	PROPOSED ZONE	ACRES	PERCENT OF TOTAL ACRES	DWELLING UNIT ANALYSIS D.U.'s	D.U.'s/AC.
Single Family	R-1	84	42.9%	306	3.3 to 3.9
Patio Homes	SU-1	22	11.2%	166	7.5
Multi-Family Low Density	R-2	24	12.2%	230	9.6
Multi-Family High Density	R-3	17	8.7%	300	17.6
Commercial	C-1	17	8.7%		
Open Space[1]	----	22	11.2%		
Education	----	10	5.1%		
		196	100.0%	1002	5.1 gross density

PLANNING DESIGN CRITERIA

Typical Single Family Parcel Area = 75' x 110' = 8250 s.f.

Typical Patio Home Parcel Area = 40' x 90' = 3600 s.f.

Residential Collector Streets @ 60' R.O.W. with 40' paving width

Residential Service Streets @ 50' R.O.W. with 32' paving width

---

[1] Includes park use as well as open space for drainage.

GENERAL PROJECT INFORMATION
ACADEMY HILLS MASTERPLAN
ALBUQUERQUE, NEW MEXICO

PROJECT TYPES

This 196 acre planned unit development includes single family detached units, traditional apartments of low and high density, zero-lot-line single family patio homes, regional and neighborhood commercial and business park facilities, and open space recreation and drainage areas. Gross density is 5.1 units per acre. An extensive open space system incorporating passive and active recreation areas, pedestrian and bicycle corridors is proposed.

PROPOSED SPECIAL FEATURES

- a variety of residential unit types
- grassed drainage ways
- pedestrian underpass
- pedestrian and bicycle corridors and linkage system
- integrated commercial area and business park

DEVELOPERS

A joint venture between Affiliated Mortgage and Development Company (A.M.D.E.C.) and Home Planning Corporation of Albuquerque, New Mexico.

Project Directors, Frank Hines, 296-5451, and Charles Haegelin, 293-2000.

PLANNING, DESIGN AND ENGINEERING

Chambers, Campbell, Isaacson & Chaplin, Inc. (CCIC), 3500 Indian School Road, Northeast, Albuquerque, New Mexico.

Project Personnel: Chaplin, Isaacson and Groth (266-5521).

NOTES

NOTES

A

DRAINAGE STUDY

FOR

ACADEMY HILLS SUBDIVISION

UNIT NO. 1

PREPARED FOR:

HOME PLANNING DEVELOPMENT CO.
5200 EUBANK, N.E.
ALBUQUERQUE, NEW MEXICO 87110

PREPARED BY:

CHAMBERS, CAMPBELL, ISAACSON & CHAPLIN, INC.
3500 INDIAN SCHOOL ROAD, N.E.
ALBUQUERQUE, NEW MEXICO 87106

JANUARY 1975

APPROVED FOR DRAINAGE

DATE

TITLE

SIGNATURE

CONTINGENCIES

E20-D2

A

DRAINAGE STUDY

FOR

ACADEMY HILLS SUBDIVISION

UNIT NO. 1

PREPARED FOR:

HOME PLANNING DEVELOPMENT CO.
5200 EUBANK, N.E.
ALBUQUERQUE, NEW MEXICO 87110

PREPARED BY:

CHAMBERS, CAMPBELL, ISAACSON & CHAPLIN, INC.
3500 INDIAN SCHOOL ROAD, N.E.
ALBUQUERQUE, NEW MEXICO 87106

JANUARY 1975

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FIGURE I LOCATION MAP - PLAT E-20-Z & E-21-Z

FIGURE II MASTER PLAN FOR ACADEMY HILLS AREA

FIGURE III TOPO MAP AND DRAINGE IN UNDEVELOPED STATE

FIGURE IV TOPO MAP AND DRAINAGE IN DEVELOPED STATE

FIGURE V TYPICAL LOT DRAINAGE PLAT

FIGURE VI TIME OF CONCENTRATION OF SMALL BASINS

FIGURE VII INTENSITY - DURATION FREQUENCY CURVE

BIBIOLOGRAPHY OF REFERENCES

PURPOSE

The purpose of this report is to analyze the drainage characteristics of the subject subdivision and make recommendations for controlling the drainage so that other urban planning for the area can be done safely.

To achieve these objectives, a two-phase approach was selected. In the initial phase, the subject property and contributing areas were analyzed in their undeveloped state. This determines the basic drainage characteristics of the area. The second phase deals with the subdivision in its developed state. Recommendations are made for compliance to the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA) requirements. Furthermore, solutions for handling off-site drainage from contributing areas will be presented.

INTRODUCTION

Academy Hills No. 1, an R-1 development, is located in the Northeast Heights of Albuquerque, north of Spain Road and west of Eubank Boulevard. The tract is bounded on the south and west by Layton Avenue, an, as yet, unbuilt street (see Figures I and II).

The overall site is characterized by rolling terrain covered with a light growth of weeds and cacti. Surface soils are predominately of loose, decomposed granite. There is an elevation drop of sixty-six feet across the site between the east and west boundaries. The average slope is 4% sloping downward to the west and southwest. The proposed subdivision, surrounded on all sides by undeveloped land, is touched at the southeast corner by the Bear Canyon Tributary. Within the bounds of the site, numerous swales and a few well defined arroyos collect and convey runoff promptly into the Bear Canyon Tributary.

Offsite, the land to the north of the proposed subdivision extends up to a ridge line which separates the Bear Canyon and the Arroyo del Pino waterbasins. Runoff originating on this area of land flows to the southwest. These flows are intercepted and contained by an arroyo which runs along the northern boundary of the Academy Hills Subdivision (see Figure III).

Offsite, the land to the east of the proposed subdivision contributes flows both in arroyo form and as sheet flow. Sheet flow has a minimal effect because of the characteristics of the soil, i.e., high permeability. However, once these flows begin to collect, arroyo actions become evident (see Figure IV).

These intercepting arroyos, both from the area to the north and the east, will have to be handled individually, with respect to the present, existing flow patterns.

Altogether, the basic concept of this report is to develop a workable plan by which the runoff flows after development of the subdivision will not exceed runoff conditions before development. Additionally, recommendations concerning offsite flows intercepting the development from surrounding areas will be presented in the following pages.

DESIGN CRITERIA

In analyzing the storm runoff, the Rational Formula, Q = CIA, was used. Where:

Q - Runoff quantity in cubic feet/second

A = Contributing area in acres

I = Intensity in inches/hour for a duration equal to the time of accumulation (duration) measured in minutes and obtained from Chart 1, Appendix A, the "Master Plan of Drainage, City of Albuquerque, New Mexico" by Herkenhoff & Associates. (Note: where a Time of Concentration (Tc) is less than ten minutes from Figure V, the Intensity value equal to ten minutes was used

as shown on the curve for a 100 year storm in Figure VII.

C = Runoff Coefficient (No Unit)

Quantities of runoff were computed on a 100 year storm frequence for both the undeveloped condition and the proposed final development form.

ESTIMATED RUNOFF - UNDEVELOPED STATE

The drainage pattern within the proposed subdivision falls into three distinct areas, designated as S-1, S-2, and S-3 (see Figure III). The runoff from these areas form the basis of comparison with the drainage of the site in its developed state. Runoff calculations are summarized in Table 1, page 4.

Offsite drainage is shown on Figure III. The offiste drainage from Area Y has the general characteristics of sheet flow, however, most flow accumulating into a natural swale in the center of the area. This swale provides the only point of run-off concentration entering the site.

Offsite drainage from area X is comprised of a series of swales and arroyos. These convey the surface flows toward the north boundary of the site. The flows accumulate into a well defined arroyo which parallels and meanders across this boundary.

The following table shows runoff in the undeveloped state:

TABLE 1

RUNOFF IN UNDEVELOPED STATE

Drainage Basin	Elev. Diff. (Feet)	Length of Flow (Feet)	Tc* (Min)	I ("/Hr)	R[1] (Unit)	Area (Acres)	Q (CFS)
S-1	50	1400	7.2	5.4	0.45	16.3	39
S-2	60	1920	10	5.4	0.45	20.1	49
S-3	38	1400	8.2	5.4	0.45	4.0	10
						Total =	98 cfs
Y	70	1800	8.5	5.4	0.45	19.9	48
X	210	6000	23	3.94	0.45	79.0	140

* From Figure VI

ESTIMATED RUNOFF - DEVELOPED STATE

Table 2 shows the results of calculations of runoff in the developed subdivision state. Figure IV shows the various drainage areas and their flows (drainage outlet points from the subdivision) include offsite flows.

Development increases the area of impervious surfaces. Therefore, runoff rates increase to a point which are greater than that which existed before development. To offset this increase, on-site restrictions of flows must be incorporated into the development of the subdivision. This can take many forms. The most practical solution for an R-1 development is to utilize on-site ponding for each lot. This approach can satisfy AMAFCA's requirement that the runoff rate from the developed tract does not exceed the runoff rate from the tract in its natural state.

---

1 Table XII, Master Plan of Drainage, City of Albuquerque, New Mexico and Environs, 1963, G. Herkenhoff and Associates. R for undeveloped areas = 0.45.

In analyzing the runoff from the individual lots, three different types of lot grading are anticipated. These types help blend the site into the existing topography, which minimizes the use of walls and abrupt elevation changes between the rear lines of the lots.

They are:

(1) Where the lot depth is perpendicular to the contours and sloping downward to the rear, the entire lot is drained and ponded at the rear, (2) where the lot depth is perpendicular to the contours and sloping downward to the front; the entire lot is drained out onto the street; (3) and finally, where the lot depth is parallel to the contours, the rear yard is used for ponding. The contributing areas to the backyard pond include the backyard, a portion of the side yards, and because of the popularity of the pitch roof design, one-half the roof area. The area drained to the street includes the front-half of the roof, a portion of the side yards, and the front yard (see Figure V).

In situations where runoff leaves the lot, a composite runoff coefficient was developed (see Appendix). This is based upon the percentage of different types of surfaces in the drainage area.

The runoff coefficient used are as follows:[2]

Streets, Walks and Drives	R = 0.90
Roofs	R = 0.90
Lawns, Sandy Soils Avg. 2 to 7% Slope	R = 0.15

The above values are only applicable for storms of five to ten year frequencies. The Rational Formula can be adjusted by a frequency factor C_f, which is used to account for antecedent precipitation conditions for greater frequency storms. A C_f

---

[2] Table 3-2, Urban Storm Drainage Criteria Manual, Volume I, Denver Regional Council of Governments

factor of 1.25 for a 100 recurrence interval was used and this adjustment was reflected in the composite runoff coefficient.[3]

The following table shows runoff in the developed state:

TABLE 2

RUNOFF IN DEVELOPED STATE

Drainage Basin	Elev. Diff.[4] (Feet)	Length of Flow (Feet)	Tc[5] (Min)	I ("/Hr)	R No (Unit)	Area (Acres)	Q (CFS)
A	68	2040	10	5.4	0.74	5.5	22
B	33	1250	7.7	5.4	0.74	3.3	13
C	36	1140	6.8	5.4	0.74	2.6	11
D	46	1350	7.4	5.4	0.74	3.3	13
E	53	1650	8.8	5.4	0.74	3.0	12
F	12	850	7.4	5.4	0.55	2.7	8
G	2	80	1.2	5.4	0.90	0.2	1
Total Internal Runoff After Development							80
Pt. I[6]	80	2400	11.5	5.2	0.74	18.7	72
Pt. II[7]	78	2700	14.0	4.8	0.46*	21.7	48

80
20
60

* Composite Factor: 2.7 acre at 0.55, 19 acre at 0.45; R composite = .12 x 0.55 + .88 x 0.45 = 0.46

3 Section 3.7 and Table 3-3 Urban Storm Drainage Criteria Manual, Volume I, Denver Regional Council of Governments

4 Obtained from estimated developed street grades

5 Obtained from Figure VI

6 Includes offsite drainage from Sub Area Y-1

7 Includes offsite drainage from Area Y-2

Explanation of Results

Pt. I and Pt. II include the total of internal flows and any external flows which pass through the subdivision, and discharge at a common point. These flows are considered actual flows since they include offsite flows entering the subdivision.

Summary of Results for the subdivision:

(1) Runoff before development (within subdivision):

Area S-1 = 39

Area S-2 = 49

Area S-2 = 10

Total 98 cfs

(2) Runoff after development (within subdivision) - sum of areas A, B, C, D, E, F and G = 80 cfs.

Therefore, summing total runoff rates under developed conditions vs. undeveloped conditions, the net result is a reduction of the total runoff rate by 18 cfs.

Furthermore, by analyzing the longest flow patterns for the undeveloped vs. the developed site, it is shown that the velocity of flow discharging at Layton Avenue is reduced after development (see Appendix for calculations).

In analyzing the volume differences for the undeveloped site vs. the developed site, there is a volume reduction of approximately 32,000 $ft.^3$ of runoff (see Appendix for calculations).

OFFSITE DRAINAGE

The offsite drainage originating on Area Y-1 will be intercepted and slightly re-routed through a drainage channel at the east boundary of the site and handled within the street system of the proposed subdivision. This section of the street

system (see Figure IV) will be able to handle the combination of flows from area Y and the related interior flows, which then empty directly into the Bear Canyon Tributary Arroyo.

The offsite drainage originating on Area X intercepts the north boundary of the proposed subdivision and meanders a short distance across this boundary before departing to the northwest. In a meeting with John B. Robert, Executive Engineer of AMAFCA, it was recommended by Mr. Robert that the possibility of intercepting the flows from drainage area X and discharging them into the streets within the subdivision be studied. Should this proposal be carried out, these flows would have to be carried in the major east-west street which runs parallel to the north boundary of the subdivision. Adding the flows from drainage area X increases the total flow in the street to 212 cfs at the west end of the subdivision. As the capacity of the street (32' wide, 8" high curbs and 6" crown) is 149 cfs this flow far exceeds the street carrying capacity. Additionally the street is planned to curve to the south and extend approximately 700 feet to the Bear Canyon Tributary. Even if a special street section such as an inverted street were used a dangerous situation would occur where runoff waters travel around such a curve. We have discussed this with the City Engineer's staff and they have informed us that they will not accept such an arrangement. Consequently it is proposed that this arroyo not be intercepted but rather allowed to follow its natural channel. In one area along the north boundary, the channel will have to be slightly re-routed and allowed to return to its historical flow pattern. By following the City Engineer's suggestion of constructing a small 20 foot wide channel west of Layton Avenue to receive these flows, the street system downstream from the subdivision can be relieved of a potentially dangerous situation.

RECOMMENDATIONS

The following recommendations are made to enable the developer of this site and the local government to complete this project within the design framework stated above.

On Site:

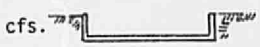
1. The ponding areas in each backyard would be best situated toward the rear of the yard. There should be a minimum of a 5 foot buffer zone between the rear property lines and the edge of the pond. This will protect any walls which might be constructed. In no case should ponded waters be allowed to stand against the wall.

2. Ponds should average six inches deep and the minimum surface area should not be less than 30%[8] of the total area drained into the pond.

3. The finished floors of the houses bordering the northern boundary of the subdivision should be kept at least 1.5 to 2.0 feet above the top of curb. This will insure adequate elevation difference between the natural drainage way and the bordering lots.

Off-Site:

1. The drainage from area Y-2 will be intercepted by a drainage channel and allowed to enter the street system of the proposed subdivision. This interception will occur quite naturally with the grading of the lots adjacent to this area. This channel will have to be lined and it will handle all the flows at a 1.5% slope with the following configuration: base 10' wide, depth of 18", flow depth of 9", freeboard of 9". This cross section will handle up to 46 cfs.



2. The drainage from Area A-2 will be intercepted by a temporary swale where

---

8 Sized for a 100 year, 24-hour storm per Technical Paper #40 as per FHA Storm Drainage Design "Guidelines" recommendations.

the natural arroyo intersects the north boundary of the site. This swale should be constructed to the following configuration: bottom width - 15', side slopes - 2:1, depth of water - 13", depth of channel - 24", top width - 23'. This cross section will handle up to 139 cfs.

SUMMARY

The R-1 development of Academy Hills Subdivision Unit 1, by utilizing the ponding procedures outlined in the developed state, will contribute less internal runoff to the downstream drainage system than that which existed before development.

In conclusion, the development of this site should have a beneficial effect on the drainage characteristics of the area.

Respectfully submitted,

CHAMBERS, CAMPBELL,
ISAACSON & CHAPLIN, INC.

Thomas O. Isaacson
Reg. N.M. L.S. & P.E. #3895

REGISTERED PROFESSIONAL ENGINEER AND LAND SURVEYOR NO. 3895 NEW MEXICO THOMAS O. ISAACSON

TOI:dk

APPENDIX

CALCULATIONS FOR RATIONAL FORMULA

1. Sample calculation for Rational Formula Q = CIA

   Area A - where:

   H = height above most remote point above outlet

   = 68 (based upon estimated development grades)

   L = distance most remote point

   = 2040

   Tc = 10 Min. Figure VI

   $I = \frac{189}{T+25}$ for 100 year storm = $\frac{189}{35}$ = 5.4"/Hr (Figure VII)

   C = 0.74 (from composite calculations) no unit

   A = 5.5 Acres

   Q = CIA

   = (0.74) (5.4) (5.5) = 22 cfs

CALCULATIONS FOR COMPOSITE RUNOFF FACTOR

2. Typical Lot Drainage to Front-Pond in Rear

   Typical 80 x 110' Lot Runoff Area Breakdown

   Impervious Area (R = 0.90)

   Street and Walk Area = (19.5 x 80) = 1560

   Roof Area (1/2 Total) = (15 x 70) = 1050

   Driveway = (30.5 x 15) = 458

   3068 ft.^{2}

Yard Area (R = 0.15)

Front and Side Yard minus drive and 1/2 roof

= (45.5 x 80) - 1508 = 2132 ft.^{2}

Total Area Drained = 5200 ft.^{2}

Area Drained under 0.90 Classification

$= \frac{3068}{5200}$ = 59% of Area Drained

Area Drained under 0.15 Classification

$= \frac{2132}{5200}$ = 41% of Area Drained

Composite Runoff Coefficient = (0.59) (0.90) = 0.53
(0.41))0.15) = 0.06

0.59

Adjust for 100 year recurrence interval:

Adjusted Factor (0.59) (C_f)
(0.59) (1.25) = 0.74

3. Typical Lot Drainage - Entire Lot to Front

Typical 80 x 110' Lot Runoff Area Breakdown

Impervious Area (R = 0.90)

Street and Walk Area	= (19.5 x 80)	= 1560
Roof Area (Total)	= (30 x 70)	= 2100
Driveway	= (30.5 x 15)	= 458
Typ. Patio	= (10 x 10)	= 100
		4218 ft.^{2}

Yard Area (R = 0.15)

Entire Lot minus roof, driveway and patio

= (115.5 x 80) - 2658 = 6582 ft.^{2}

Total Area Drained = 80 x 135 = 10,800 ft.^{2} (includes 1/2 of street)

Area Drained under 0.90 Classification

$= \frac{4,218}{10,800} = 39\%$ of Area Drained

Area Drained under 0.15 Classification

$= \frac{6,582}{10,800} = 61\%$ of Area Drained

Composite Runoff Coefficient = (0.39) (0.90) = 0.35
(0.61) (0.15) = 0.09

0.44

Adjust for 100 year recurrence interval:

Adjusted Factor = (0.44) (Cf)
= (0.44) (1.25) = 0.55

The lots facing Layton Avenue have a greater amount of impervious surface contributing to runoff, i.e., 28.6 feet of road and sidewalk vs. 19.5 feet for a 32' B-C Street. Correspondingly, there is an increase in previous surface between the property line and the edge of sidewalk, i.e., 14.4 feet vs. 5.5 feet for a 50' R/W.

Calculations were made for the composite runoff factor for these lots, and it was the same as the "C" factor for a typical 80' x 110' lot on a 50' R/W, i.e., C = 0.74.

CALCULATIONS FOR COMPARING VELOCITIES IN UNDEVELOPED STATE vs. DEVELOPED STATE

1. a. Analyzing the largest natural drainage pattern in undeveloped state.

(Arroyo in drainage area S-2, Figure II)

Area = 34.8 Ac; length of flow = 3900'

Elev. Difference = 130'; use R = 0.45

Tc = 17.1, I = 4.49"/hr.

Q = AIR

Q = (34.8) (4.49) (0.45) = 70 cfs

b. By trial and error, determine the channel (arroyo) flow area.

<u>Final Trial</u> arroyo shape

Slope = 0.035
S 1/2 = 0.19

Assume depth of flow = 1.42':

Wetted Perimeter = 8.09

Area = 7.70 s.f.

$\therefore Q = \frac{1.486}{n} \frac{a\ 5/3}{p\ 2/3} S\ 1/2$ Where S = 3.5% and n = 0.030

Manning Formula: $Q = A \frac{1.486}{n} r2/3\ S1/2$

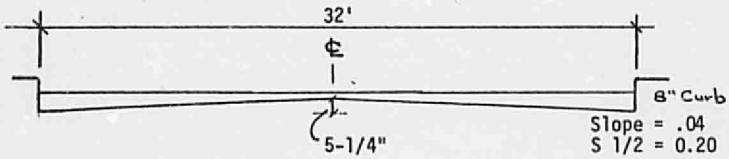
$Q = 7.70 \times \frac{1.486}{0.030} \times 0.97 \times 0.19 = 70$ cfs, OK

$V = Q/A = \frac{70}{7.70} = 9.09$ fps

2. a. Analyzing the "discharging" street along the top of the subdivision in developed state.

Q = 72 cfs (Point I - drainage report)

b. By trial and error, depth of water at the curb = 0.56



Slope = .04
S 1/2 = 0.20

Area = 10.88 ft.^{2}

Wetted perimeter = 33.12

$\therefore Q = 10.88 \times \frac{1.486}{0.022} \times .47 \times 0.20 = 69$ cfs, OK

$V = Q/A = \frac{69}{10.88} = 6.34$ fps

CALCULATIONS FOR COMPARING VOLUMES IN UNDEVELOPED STATE vs. DEVELOPED STATE

1. Volume based upon a 3" - 6 hr./100 year storm

   a. Undeveloped Subdivision:

      Area = 40.4 Ac.

      R = 0.45

      Volume of Runoff = Area x "R" x Rainfall

      = 1,759,824 $ft.^2$ x 0.45 x 0.25 = 197,980 $ft.^3$ of runoff water

   b. Developed Subdivision:

      Area = 20.6 Ac.

      R = 0.74

      V = 897,336 $ft.^2$ x 0.74 x 0.25

      = 166,007 $ft.^3$ of runoff water

   c. Total Volume Runoff Reduction = 31,973 $ft.^3$ of runoff water.

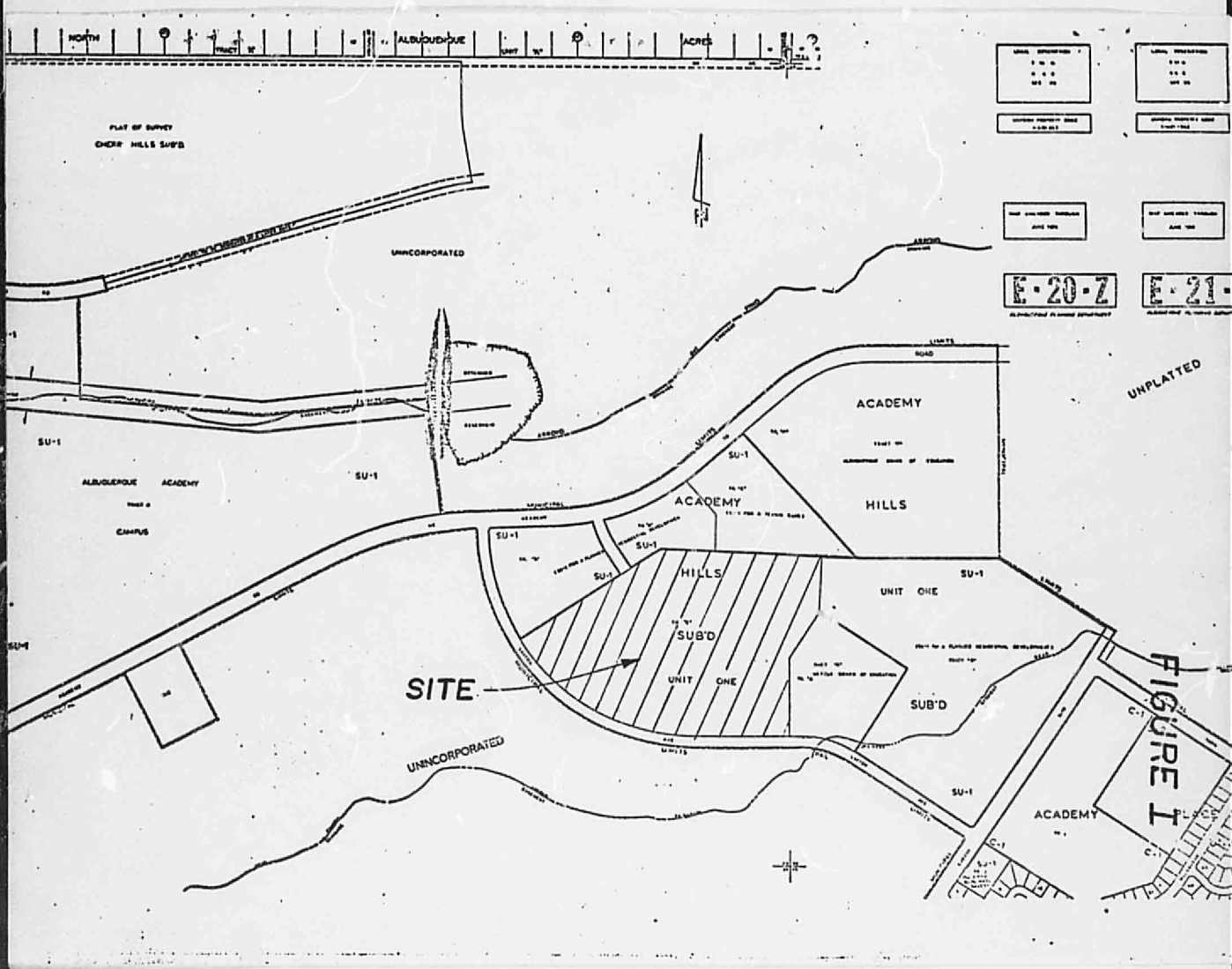
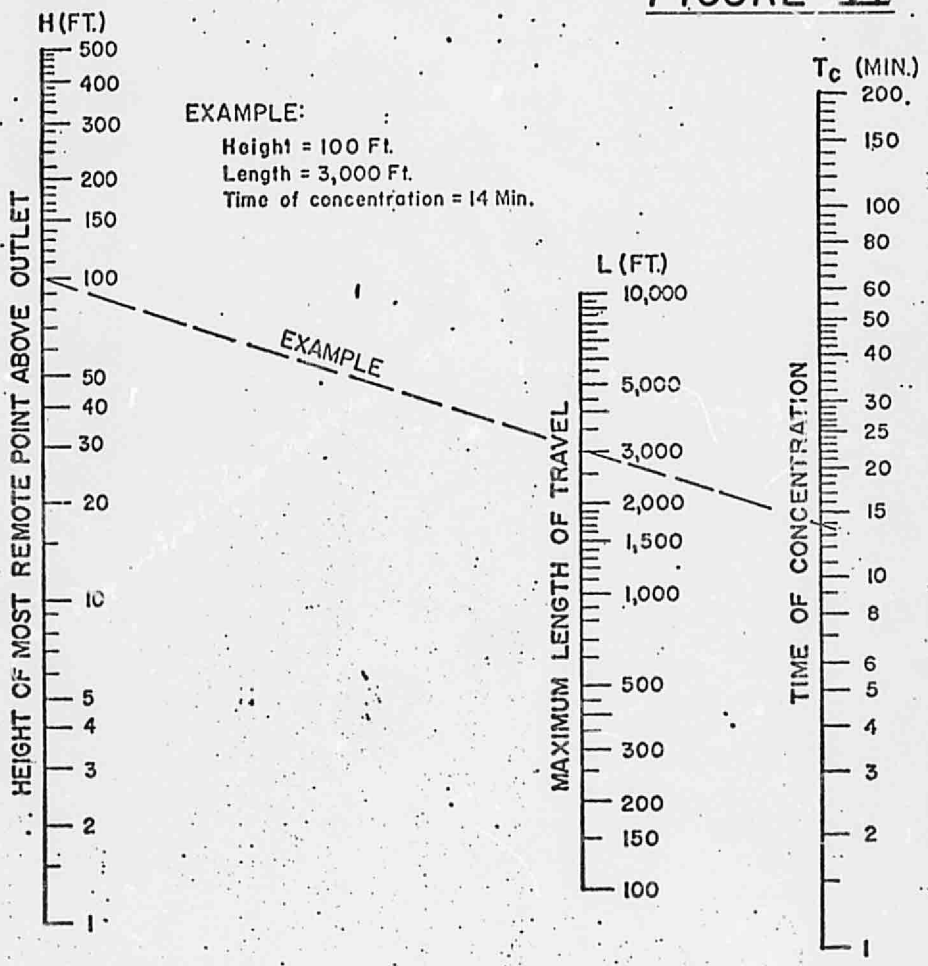

NORTH
ALBUQUERQUE
ACRES
PLAT OF SURVEY
CHERR HILLS SUB'D
UNINCORPORATED
E-20-Z
E-21-
UNPLATTED
ACADEMY
HILLS
SU-1
ALBUQUERQUE ACADEMY
CAMPUS
HILLS
SUB'D
UNIT ONE
SITE
UNINCORPORATED
SUB'D
ACADEMY
C-1

FIGURE I

FIGURE VI

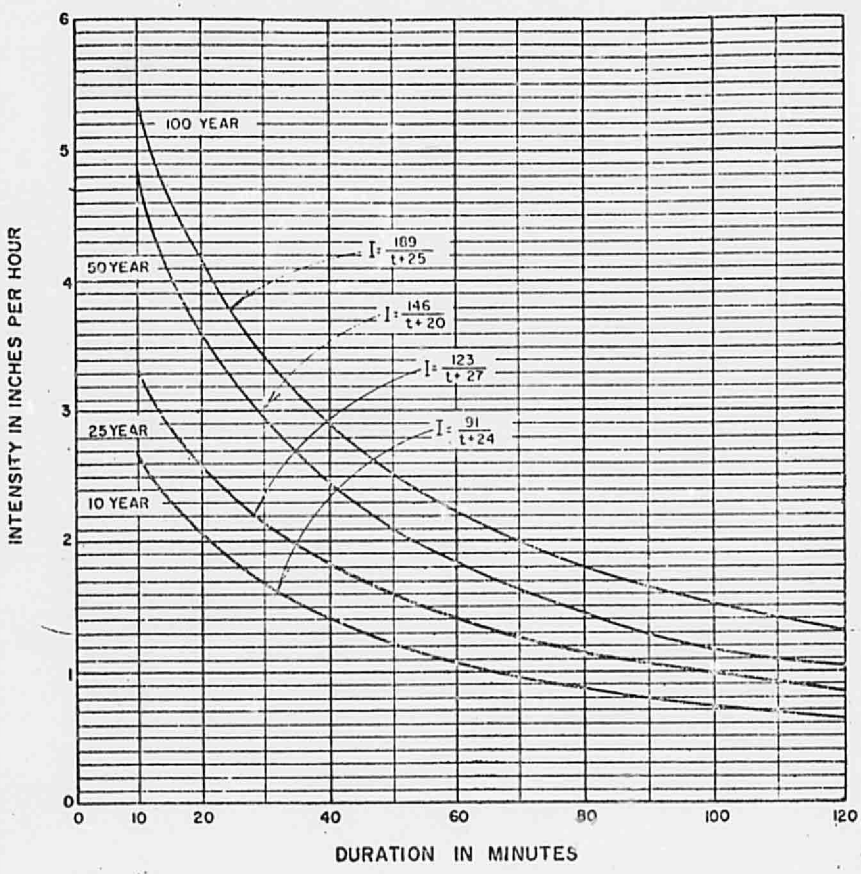


Based on study by P. Z. Kirpich,
Civil Engineering, Vol. 10, No. 6, June 1940, p. 332

TIME OF CONCENTRATION OF SMALL DRAINAGE BASINS

Reprinted from "Design of Roadside Drainage Channels - Hydraulic Engineering Circular No. 6", April 1962, U. S. Dept.

FIGURE VII



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

INTENSITY DURATION
FREQUENCY CURVES

(ALBUQUERQUE AREA - 1961)

GORDON HERKENHOFF & ASSOC
CONSULTING ENGINEERS
ALBUQUERQUE, NEW MEXICO

CHART
1

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ACADEMY HILLS PROPERTIES

MASTER PLAN OF DRAINAGE

PREPARED FOR

HOME PLANNING DEVELOPMENT COMPANY, INC.

AND

AFFILIATED MORTGAGE AND DEVELOPMENT COMPANY

BY

CHAMBERS, CAMPBELL, ISAACSON & CHAPLIN, INC.

JANUARY 1976

REVISED MAY 1976

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JANUARY 1976

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A) PURPOSE AND SCOPE

Home PLanning Development Company, Incorporated, in conjunction with Affiliated Mortgage and Development Company have retained this firm to devise a Master Plan of Development for Academy Hills Properties, including Subdivision Units 2 and 3, in northeast Albuquerque. As a contingency to approval of said Master Plan, a Master Drainage Study is required by the City of Albuquerque and the Albuquerque Metropolitan Arroyo Flood Control Authority. This report details the results of that study.

Since the parcel of land known as Academy Hills is presently in various stages of subdivision and development, the scope of work for this study varies for different sections of that parcel. For those areas where preliminary interior plats have been devised, detailed drainage patterns are defined. For those areas where nothing more than a specific type of land use has been chosen, drainage is treated in very general terms.

B) SITE LOCATION AND TOPOGRAPHY

Academy Hills Subdivision is located in northeast Albuquerque immediately west of the proposed intersection of the extensions of Eubank and Juan Tabo Boulevards (see Location Map). The land slopes from east to west at an average rate of 4%. Soils consist largely of alluvial sands and silts, and decomposed granite is the major soil constituent.

C) EXPLANATION OF NUMBERED AREA DESIGNATIONS

Plate I shows the areas east of Academy Hills which drain toward and onto the property naturally. Plate II shows the site itself with drainage areas

LOCATION MAP

broken down into logical sub-areas convenient for analysis. Each sub-area of drainage is designated by a number followed by a dash followed by another number. The first number indicates the land use type according to the following code chart. The code chart follows that used on the Master Plan of Development where applicable:

Code #	Land Use Type
1	Townhouse type development with up to 9.6 units per acre.
2	Commercial/Office Park type development containing non-industrial types of businesses.
3	Patio Home type development with up to 7.5 units per acre.
4	Multi-story Apartment Complex type development with up to 17.6 units per acre.
5,6,7	Single Family type development with 3.3 - 3.9 units per acre.
10	Dedicated Public Park
11	Board of Education School site
13	Off-site upland drainage areas.

The second number in the area designation code represents specific sub-areas within each land use type.

D) DESIGN CRITERIA

1) Engineering Parameters: For calculation of composite coefficients of runoff the following values of "C" were taken for the indicated land coverages:

a) Streets, roofs, walks - 0.90

b) Lawns - 0.15

c) Southwestern landscaping - 0.6

d) Natural ground - 0.35

e) Bare earth - 0.45

2.6"

All runoff volume calculations have been based on a 100 year-6 hour rainfall of 2.2" per AMAFCA requirements.

Rate of runoff calculations have been based on the frequency - intensity - duration relationship for a 100 year storm as presented by Gordon Herkenhoff and Associates in their 1963 Master Plan of Drainage for the City of Albuquerque. This relationship is expressed by the following equation: $I = 189/(Tc+25)$

2) Flood Control Regulations: The drainage plan presented in this report has been designed to comply with the 1972 AMAFCA Resolution in regard to rate and volume of runoff leaving the site. That Resolution has been interpreted to say that the rate and volume of runoff allowed to leave the site after development shall be no greater than the rate and volume running off prior to development.

E. COMPUTATIONAL PROCEDURES

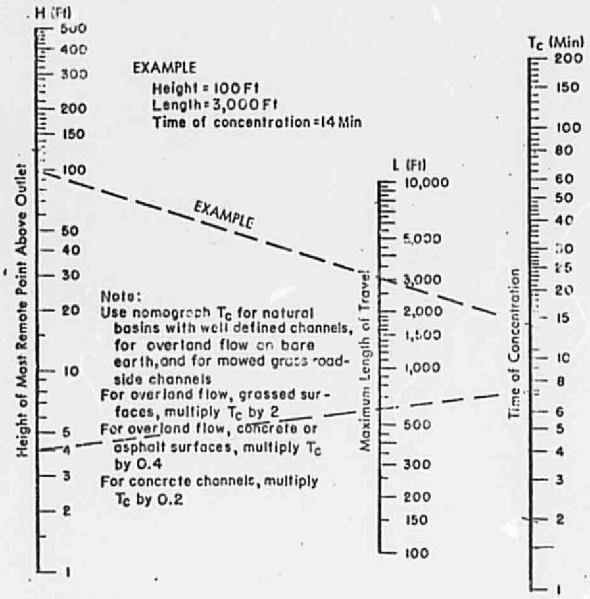
Appendix A contains samples of the various types of hydraulic calculations performed. Proposed easement channels were sized based on the Manning equation for uniform flow. Street carrying capacities were taken from Table IV which was developed by Gordon Herkenhoff and Associates for their aforementioned study and which is reproduced in this report (see Page 17).

Hydrological flow rate calculations are based on the rational runoff method. Times of concentration were calculated using Plate V for overland flow and Table IV for estimating street flow velocities. Estimates were made of percents of area covered by each coverage type described above in section D-1 for each drainage sub-area. A composite runoff coefficient was than calculated for each sub-area.

Volume calculations for sizing individual lot ponds, for determination of

PLATE V

NOMOGRAPH
TIMES OF CONCENTRATION



Based on study by P. Z. Kirpich,
Civil Engineering, Vol. 10, No. 6, June 1940, p. 362

overall ponding requirements for land use areas 1, 2, 4 and 11, and for determination of net volumes of discharge for the entire site in both natural and developed states were performed by multiplication of the applicable C factor times the 100 year - 6 hour rainfall (0.183) times the appropriate area to obtain cubic feet of water.

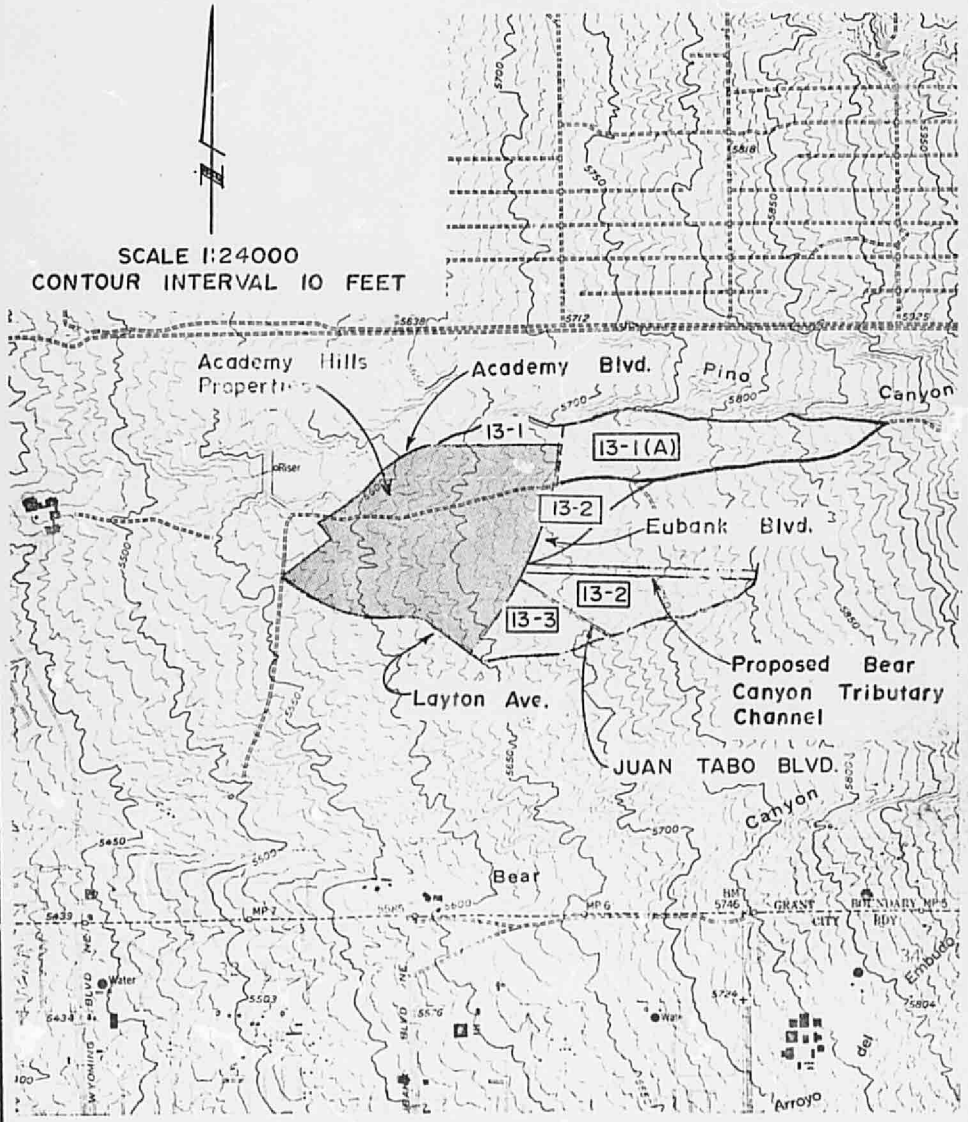
F) OFF-SITE DRAINAGE

1) Bear Canyon Tributary: A major drainage conveyance known as the "Bear Canyon Tributary" cuts through the southeastern corner of the property. The 100 year flow rate for this arroyo has been taken from a drainage study conducted by Leonard Rice and Associates for AMAFCA dated April, 1975, and it is equal to 1326 cfs in the existing state and 1400 cfs under the implemented drainage management plan for the location at the Eubank Juan Tabo intersection.

The plan presented here deviates from the Rice proposal moderately and is illustrated on Plates III and IV. We feel that these differences do not interfere with the hydrological validity of the Rice study. We propose that a broader, shallower channel with a maintained grass bottom be adopted so that the conveyance will serve a recreational function during times of low flow. The channel will have a bottom width of 176' between transitions at Eubank and Layton Boulevards, and the minimum depth of the proposed section will be 3'. A small "trickle" section will be provided along the southern easement line to carry the "nuisance" flows which will be generated by storms of lesser intensity. In accordance with Mr. John Robert's request, we have shown a 100' long section of wire enclosed rip rap at the upper end of this "nuisance" channel to serve as an infiltration section for small flows.

PLATE I

UPLAND DRAINAGE



The Rice Study recommends a bridge structure and energy dissipator for the Eubank crossing of the Bear Canyon Tributary. No funds are presently available for such improvements, however, we must assume that ultimately they will be constructed. When a bridge and dissipator structure are planned for Eubank Boulevard, the dissipator will solve any transitional problems by slowing the flows down to the point where the transition can be made at sub-critical velocities.

2) Properties East of Eubank: Outlined on Plate I are three distinct drainage areas which approach the subject property form the east. The natural divide between areas 13-1 and 13-2 intersects Eubank Boulevard approximately 600' south of the northeast property corner. Flows from area 13-1 can therefore be diverted northward on Eubank and into Academy Boulevard where they will eventually be dumped into the Pino Arroyo to the north. Flows from areas 13-2 can be diverted via Juan Tabo and Eubank Boulevards into the Bear Canyon Tributary where it crosses Eubank.

Flows from area 13-3 can be diverted southward down Eubank and then into Layton Boulevard where again, they can be dumped into the Bear Canyon Tributary where it crosses Layton Boulevard. have to water block Eubank - not shown as part of grades for P.D. 184. S.D in PD 184 may require easement in area 4-1

G) ON-SITE DRAINAGE

1) Area 6-1 - Approved Drainage Report: No calculations were performed regarding Area 6-1. A drainage report has been conducted by this office for that area, and that report has been approved by AMAFCA. The reader is referred to "A Drainage Study for Academy Hills Subdivision Unit No. 1", January, 1975,

and the subsequent addendum thereto dated the same.

2) Methods of Treatment for Other Land Use Areas: As mentioned previously, specific land use areas have been treated with varying degrees of detail based on the extent of land planning to date for each area. Areas 1, 2, 4 and 11 have been treated in the most general fashion with only overall runoff contributions and overall ponding requirements calculated for each. Since Areas 10 will be open, grassed park, it was necessary to include only their net effect upon runoff and ponding requirements for the entire site.

Even though no preliminary plat has been devised for Area 3, a maximum number of lots has been proposed in the Master Plan, and therefore, a typical plot plan for the patio homes proposed for this area has been assumed. This plot plan is shown as Plate VI and indicates that the majority of each lot shall drain into an infiltration gallery in the rear so that volume discharge requirements can be met.

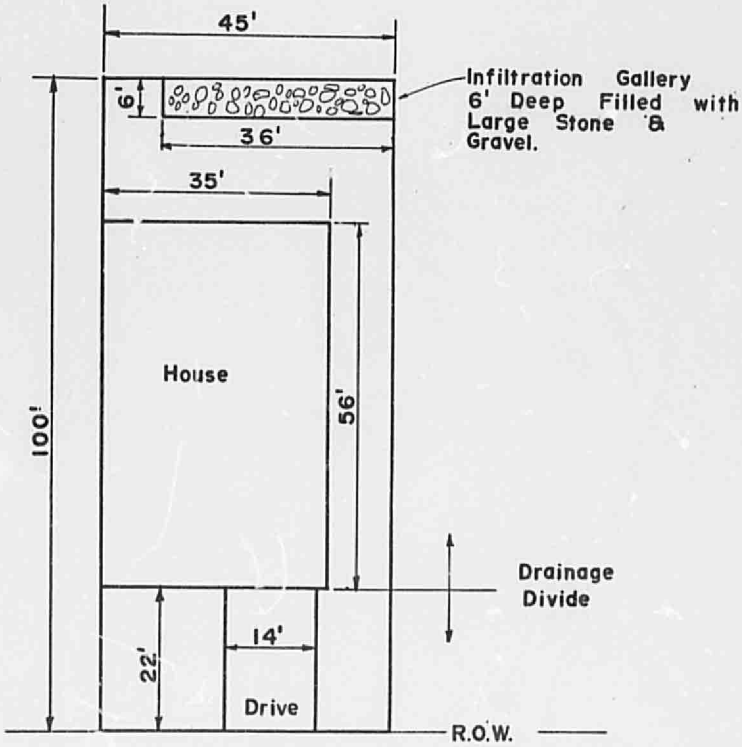
Preliminary plats have been devised for areas 5 and 7, so these areas have been treated in the most detailed fashion. Plate VII shows a typical plot plan for an R1 lot located in Areas 5 or 7. Again, the majority of runoff travels to the rear of the lot where it is ponded in a back yard retention pond for percolation into the soil.

3) Volumes of Runoff: Table 1 itemizes the individual drainage sub-areas along with Composite C values and volume calculations. Volumes are given for each sub-area for both the developed and undeveloped states. In those cases where back yard ponding does not apply, total required ponding volumes are indicated (ponding volumes are not given for park areas since runoff after development will be less than what occurs naturally). A final

PLATE VI

TYPICAL PLOT PLAN
PATIO HOME

N.T.S.



HYDROLOGY E20/D2 2 of 2 8 PLANS

PLATE VII

TYPICAL PLOT PLAN
R-I RESIDENTIAL HOME

N.T.S.

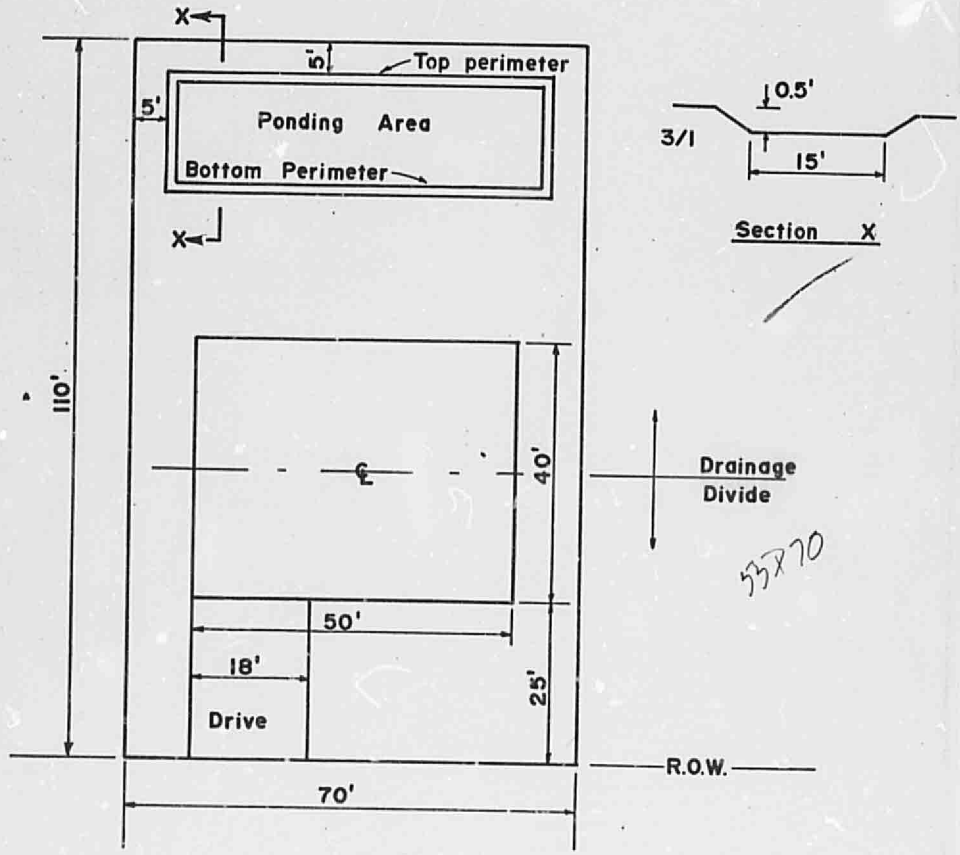


TABLE I

VOLUME CALCULATIONS

Area Designation	Area (acres)	Area Running Off If B.Y. Ponding Applies	% Area Running Off @ .9	% Area Running Off @ .15	% Area Running Off @ .6	% Area Running Off @ .35	% Area Running Off @ .45	Composite C	Natural Volume 100 Year 6 hr. Storm cu. ft.	Developed Volume 100 Year 6 hr. Storm cu. ft.	Required Retention B.Y. Ponding Does Not Apply cu. ft.
2-1	19.1	NA	50	15	25	000	10	.67	53386	102197	48811
1-2	7.8	NA	41	25	25	000	9	.6	21801	37374	15573
1-1(A)	1.9	NA	50	00	00	000	50	.68	-----	------	-----
1-1	18.0	NA	41	25	25	000	9	.6	50312	86249	35937
7-1	5.3	3.1	45	27	28	000	00	.61	14810	15100	-----
7-3	2.4	NA	50	000	00	000	50	.68	6696	13009	-----
7-5	1.7	1.0	49	25	26	000	00	.63	4750	5030	-----
7-2	11.4	7.3	49	25	26	000	00	.63	31860	36730	-----
7-4	0.7	NA	50	000	00	000	50	.68	1953	3794	-----
3-1	2.5	.9	47	26	27	000	00	.62	6988	4456	-----
3-2	19.0	9.9	47	26	27	000	00	.62	53107	49018	-----
10-1	1.7	NA	00	100	00	000	00	.15	4752	2036	-----
10-2	2.7	NA	00	100	00	000	00	.15	7547	3234	-----
5-6	4.4	3.1	53	23	24	000	00	.66	12276	16310	-----
11-1	10.9	NA	25	000	00	000	75	.56	30467	48747	18280
5-1	2.0	1.5	51	24	25	000	00	.65	5590	7790	-----
5-2	3.9	2.3	54	23	23	000	00	.66	10881	12101	-----
5-3	6.8	3.9	54	23	23	000	00	.66	19007	20556	-----
5-4	5.7	3.3	50	25	25	000	00	.64	15932	16866	-----
10-6	1.4	NA	13	87	00	000	00	.25	3913	2795	-----
5-5	6.0	3.7	48	26	26	000	00	.63	16740	18582	-----
10-3	3.0	NA	00	100	00	000	00	.15	8385	3594	-----
4-1	17.3	NA	50	15	25	000	10	.67	48355	92566	44211
4-1(A)	4.9	NA	53	000	00	000	47	.69	-----	------	-----
13-1	93.7	NA	00	000	00	100	00	.35	-----	------	-----
13-2	71.6	NA	00	000	00	100	00	.35	-----	------	-----
13-3	35.1	NA	00	000	00	100	00	.35	-----	------	-----
12-1	3.6	NA	53	000	00	000	47	.69	-----	------	-----
13-1(A)	82.2	NA	00	000	00	100	00	.35	-----	------	-----
									Summary	(with req. ret.) Summary	
									429,508	435,322	

NOTE: Areas Designated "A" are included in gross area indicated for parent designation.

TABLE II

FLOW CALCULATIONS
DEVELOPED STATE

Point Designation	Areas Contributing	Travel Length (feet)	Vel. (fps) ΔH (feet)	Tc (minutes)	I 100	Q = Σ(CIA) c.f.s.*
D	2-1	1700	70	8	5.4	36
I	1-2	1350	35	8	5.4	15
H	1-1 less 1-1(A), 1-2, 7-5	2000	66	10	5.4	49
V	2-1, 1-1(A), 13-1	1050 ** 5000	12.5 fps 190	20½	4.15	169
W	7-1	850	26	6	5.4	10
T	1-2, 1-1 less 1-1(A), 7-5, 7-3, 7-1	900 2000	12.5 fps 66	11	5.25	66
X	7-2, 7-4	950	48	4½	5.4	27
E	3-1	800	30	5	5.4	3
F	3-1, 3-2	1400	42	8	5.4	36
G	5-2	800	10 fps	1	5.4	8
O	5-6, 10-2, 10-1, 3-1, 3-2	1100 1400	6.8 fps 42	10½	5.32	50
J	11-1	1000	30	6	5.4	21
K	11-1, 5-1, 5-2	200 1000	5.6 fps 30	6½	5.4	24
L	11-1, 5-1, 5-2, 5-3	500 1000	5.6 fps 30	7½	5.4	48
M	11-1, 5-1, 5-2, 5-3, 5-4	800 1000	5.6 fps 30	8½	5.4	59
P	11-1, 5-1, 5-2, 5-3, 5-4, 5-5 10-6	1200 1000	5.6 fps 30	9½	5.4	73
C	13-1 (A)	5000	190	19	4.3	124
N	4-1(A), 13-3	800 2000	10.5 fps 70	11½	5.18	81
B	12-1, 13-2	3600	120	16	4.61	127

* C = 0.35 was used for Q calculations for areas 1-1, 1-2, 2-1, and 11-1, to account for effect of proposed ponding.

** 1050' path along streets; 5000' path overland flow; Tc is total of the two flow times.

tally of runoff volumes before and after development (including the effects of all recommended ponding) is given at the end of Table 1. Volume after development with proposed ponding (435,322 cu. ft.) is essentially equal to volume before development (429,508 cu. ft.), thereby complying with the AMAFCA Resolution.

4) Drainage Networks: Plate II indicates the positions of all drainage control points used in flow calculations. These consist of individual letters within circles, and flow rates for each control point can be read from Table II. Four basic drainage networks exist for the Academy Hills Site. The first consists of Areas 13-1, 2-1, and 1-1(A) which all drain into Academy Boulevard and converge at point V. Since these areas drain to point V naturally, it is proposed that a dip section be provided in Academy Boulevard at point V so that these flows can be discharged into the natural depression which leads northwesterly into the Pino Basin.

The second network consists of areas 1-2, 1-1 less 1-1(A), 7-1, 7-3, and 7-5 converging at point T. Here another natural depression leads northward to the Pino Basin. Since this second network represents a slight rearrangement of what occurs naturally, we recommend that an easement be acquired to accommodate these flows as shown on Plate II and as indicated in Table III.

The third network is composed of areas 5-6, 10-1, 10-2, 3-1, and 3-2. These areas drain to point O where they will be directed into the Bear Canyon Tributary.

The fourth network drains to point P at the intersection of Concordia and Layton. This network contains areas 11-1, 5-1, 5-2, 5-3, 5-4, 5-5, and 10-6. Since the Bear Canyon Tributary at Layton Avenue is actually higher

than the intersection of Concordia and Layton, it is not feasible to drain these flows eastward into the tributary. The only practical solution is to allow these flows to travel westward down Layton Avenue to join the flows from Academy Hills Drive. At the intersection of Layton Avenue and Academy Hills Drive, these flows will travel southwesterly along an existing natural arroyo and into the Bear Canyon Tributary.

? do not like this. Flows need to be in arroyo.

The landowner to the south of Layton Avenue has committed himself in writing to providing whatever easements or watercourses AMAFCA may deem necessary when he develops his land. At that time, flows along Layton Avenue could be intercepted at a more easterly location and diverted into the Bear Canyon Tributary via said easement or watercourse.

? where when,

Flows from area 7-2 and 7-4 are minimal (approximately 27 cfs) and can therefore be allowed to travel down Academy Road to a discharge point further east. Location of said discharge point will depend upon whatever development occurs east of the Academy Hills Site.

No

At locations F, T and W easements and corresponding easement channels are proposed. Table III describes the geometry of these easements and their respective channels.

Table V contains information regarding adequacy of proposed street sections.

H) SUMMARY OF RECOMMENDATIONS

In conclusion and as a result of the analysis presented above, we make the following recommendations with regard to drainage for the Academy Hills Subdivision:

1) That a grass surfaced conveyance channel with the dimensions shown on Plates III and IV be provided to carry flows originating in the Bear Canyon Tributary.

2) That all other off-site drainage approaching the subject property from the east be rerouted around the property via Academy, Eubank, and Layton Boulevards.

3) That the typical plot plans illustrated on Plates VI and VII for Patio and R1 Residential homes respectively be adopted in the final grading design.

4) That retention facilities of the capacities indicated in Table I be incorporated into the final grading designs for Areas 2-1, 1-1, 1-2, 4-1 and 11-1.

5) That the easements proposed in Table III be acquired and the corresponding easement channels be installed.

6) That the street sections proposed in Table V be adopted for the locations indicated.

TABLE III

DRAINAGE EASEMENTS AND CHANNELS

Point Designation	Flow Rate (c.f.s.)	Required					
		Channel Slope (ft./ft.)	Channel Bottom Width (feet)	Channel Depth (feet)	Channel Sideslopes (horz./vert.)	Channel Lining	Easement Width (feet)
F	36	0.011	10	1.0	0	Concrete	12
T	66	0.0025	10	1.5	3	Concrete	20
W	10	0.003	8	0.67	0	Concrete	10

TABLE IV

STREET CARRYING CAPACITIES
(CFS)

Slope	32' Street 6" Crown at center line or 6" sidehill with no crown	32' Street Flat Cross-section	32' Street 6" Inverted crown at center line	32' Street with 8" sidehill with no crown	32' Street with 12" sidehill with no crown	40' Street 6" Crown at center-line or 6" sidehill with no crown	44' Street 6" Crown at center-line or 6" sidehill with no crown	48' Street 6" Crown at center-line or 6" sidehill with no crown
0.0025	37	78	133	25	17	47	51	56
0.0050	53	111	189	36	23	66	72	79
0.0075	65	136	231	44	29	81	89	97
0.0100	75	156	267	51	33	93	102	112
0.0125	84	175	299	57	37	104	115	125
0.0150	92	193	328	62	41	114	126	138
0.0175	99	207	352	67	44	123	135	148
0.0200	105	221	376	71	47	131	144	158
0.0225	112	235	400	76	50	139	154	168
0.0250	118	247	422	80	52	147	162	177
0.0275	124	260	444	84	55	155	170	185
0.0300	129	271	462	88	57	161	177	193
0.0325	134	282	480	91	59	167	184	202
0.0350	139	293	499	95	62	174	191	209
0.0375	145	304	518	98	64	180	199	217
0.0400	149	313	534	101	66	186	205	224
0.0425	154	322	550	104	68	192	211	231
0.0450	158	332	566	107	70	197	217	237
0.0475	163	341	582	110	72	203	223	244
0.0500	167	350	598	113	74	208	230	251

Coefficient of Roughness = n = 0.015 for all streets.
Carrying Capacity Given in Cubic Feet per Second (C.F.S.)
Arterial Design (Stage & Final) has a +2% Slope from the Top of Curb to the top of Median Curb.
Curb Height = 8"

Reproduced from "Master Plan of Drainage for the City of Albuquerque" by Gordon Herkenhoff and Associates, 1963.

TABLE V

REQUIRED STREET SECTIONS

Point Designations	Street Name	Flow Rate (c.f.s.)	Recommended Street Width (feet)	Recommended Street Slope (ft./ft.)	Actual Capacity
C	Academy	124	48	.05	251
V	Academy	169	48	.05	251
N	Layton	81	48 (designed)	.018 (designed)	150
P	Concordia	72	32	.01	75
Below P	Layton	72	48 (designed)	.007 (designed)	94
O	Admiral Emerson	50	32	.025	118

APPENDIX A

SAMPLE CALCULATIONS

1) Composite Runoff Coefficient - Area 2-1:

Estimated

% area running off @ .9 = 50

% area running off @ .15 = 15

% area running off @ .6 = 0

% area running off @ .35 = 10

$\therefore$ C (composite) = (0.5 x 0.9) + (0.15 x 0.15) + (0.25 x 0.6) + (0.1 x 0.45) = 0.67

2) Volumes of Runoff = Area 2-1:

Area = 19.1 acres = 831,996 sq. ft.
Rainfall = 2.2" = 0.183 feet

a) Undeveloped:

C = 0.35

$\therefore$ Volume = 0.35 x 0.1833 x 831,996 = 53,386 cu. ft.

b) Developed:

C (composite) = 0.67

$\therefore$ Volume - 0.67 x 0.1833 x 831,996 = 102,197 cu. ft.

3) Flow Rate - Point U:

T_c (Point U) = 12 min.
$\therefore$ I (Point U) = 189/(25+12) = 5.1 in./hr.

$Q = (C \times I \times A)$

$= 0.15 \times 5.1 \times 1.5$ (Area 10-4) $+ 0.63 \times 5.1 \times 9.8$ (Area 7-2) $+ 0.61 \times 5.1 \times 6.4$ (Area 7-1) $= 33$ cfs

4) <u>Easement Channel Capacity - Point F</u>:

Q = 36 cfs
Available slope = 0.013
Bottom width = 0'
Sideslopes = 3/1
n = 0.03 (earth)

from Manning equation: $Q = (A)\frac{(1.49)}{n}(R)^{2/3}S^{1/2}$

Solving by trial and error

Depth = 1.6'

∴ A 2' deep channel and a 12' wide easement shall be satisfactory.

5) <u>Required Volume for Infiltration Gallery - Patio Homes</u>:

Area running off = 45 x 78 = 3510 sq. ft.

% area running off @ .9 = 56

% area running off @ .15 = 15

% area running off @ .35 = 0

% area running off @ .45 = 15

Composite C = 0.68

Volume = 0.1833 x 0.68 x 3510 = 438 cu. ft.

Typical value for void ratio (e) of loose sand = 0.89

Porosity = $\frac{\text{Vol. voids}}{\text{Vol. total}} = \frac{e}{1+e} = 0.47$

I'll use 0.33 to be conservative.

Volume of an area 6' x 36", two feet deep = 432 cu. ft. OK

∴ An area 6' x 36' x 6' deep filled with gravel will serve as an adequate infiltration gallery.

6) Required Back Yard Ponding Volume - R1 Home:

Area running off = 65 x 70 = 4550 sq. ft.

% area running off @ .9 = 26

% area running off @ .15 = 26

% area running off @ .6 = 24

% area running off @ .35 = 0

% area running off @ .45 = 24

Composite C = 0.55

Volume = 0.1833 x 0.55 x 4550 = 459 cu. ft.

A pond having 3/1 sideslopes, 0.5' deep, with bottom dimensions of 57 by 15 has a volume of approximately 16.5 x 57 x 0.5 = 470 cu. ft. OK

7) Bear Canyon Tributary - Channel Design:

a) 176' Wide Section (Normal Flow Depth)

Q = 1400 cfs
BW = 176'
Slope = .03
Sideslopes = 4/1
n = .03 (grass)

From manning equation

Depth = 0.96'
Velocity = 8.2 fps
Froude = 1.49

b) <u>100' Wide Section at Layton (Normal Flow Depth)</u>

Q = 1400 cfs
BW = 100'
Slope = .03
Sideslopes = 22.75/1
n = .03 (assume critical section is just outside of street limits in grassed ROW)

From manning equation

Depth = 1.25'
Velcoity = 8.69 fps
Froude = 1.51

Since both sections are well within the supercritical range, flow should pass through the transition and over the Layton dip section with only minor head losses due to the contraction. These losses are estimated as:

$$0.1 \times \frac{V2^2 - V1^2}{2g}$$ (per Corps of Engineers and are equal to

$$0.1 \times \frac{8.69^2 - 8.2^2}{64.4}$$

= .013' which is negligible

In the event that the channel below Layton is not designed to run supercritically, a hydraulic jump will occur somewhere upstream of Layton. Checking conjugate depths for the two sections described above yields the following:

c) <u>176' Wide Section (Conjugate Depth)</u>

Depth (up) = 0.96'
Velocity (up) = 8.2 fps

For very wide trapezodial sections, the hydraulic jump formula for rectangular sections can be applied with very small error.

$$\text{Depth (down)} = -\frac{0.96}{2} + \sqrt{\left(\frac{0.96}{2}\right)^2 + \frac{2(8.2)^2(0.96)}{g}}$$

Depth (down) = 1.58'

d) <u>100" Wide Section at Layton (Conjugate Depth)</u>

Depth (up) = 1.25'
Velocity (up) = 8.69 fps

$$\text{Depth (down)} = -\frac{1.25}{2} + \sqrt{\left(\frac{1.25}{2}\right)^2 + \frac{2(8.69)^2(1.25)}{g}}$$

Depth (down) = 1.88'

The above calculations show that even if a hydraulic jump occurs upstream of Layton, the conjugate depth will be less than 2'. Therefore a 3' deep channel will provide adequate freeboard.

CITY OF ALBUQUERQUE

ALBUQUERQUE, NEW MEXICO

INTER-OFFICE CORRESPONDENCE May 5, 1981 REF. NO._____

TO: Richard S. Heller, City Engineer

FROM: Bruno Conegliano, Assistant Hydrology Engineer B.C.

E21/D2

SUBJECT: ACADEMY HILLS, UNIT 4 DRAINAGE

While reviewing the drainage report for Academy Square prepared by Mr. Dick Vaughn with Design Professionals, I had occasion to re-examine the drainage report prepared for Academy Hills, Unit 4-6 by Mr. Kent Whitman with Community Sciences Corporation.

In my review of the files, I found that a short time after the plat for Academy Hills 4 was signed off (January 5, 1978, 93 R-1 lots on 28.632 ac), twenty five replats and summary plats were submitted to and approved by the City. Most of the replats were prepared by the original surveyor for the original developer with the apparent intent of changing at least a portion of the single family subdivision to a townhouse development. It is my opinion that the procedure followed constitutes a direct violation of the fundamental purpose of the Subdivision Ordinance, of the Sector Development Plan approved by the City, of the AMAFCA Resolution 72-2 and ultimately challenging the use and significance of local government control of development activities.

While I will not elaborate further on the last item mentioned, I will point out the problem that this approach represents for the management of the drainage. As you are aware Academy Rd. east of Wyoming Blvd. and adjacent to the Lands of The Boys' Academy is presently unimproved. Approval of the construction of the several units of the Academy Hills Subdivision was granted upon committment by the developer to the interception of the flows generated by the new development; these flows were to be collected with some inlets and storm sewers and discharged in the Pino Arroyo. The design of the storm sewer was based on the assumption that the use of backyard ponds, provided with each R-1 lot, would make most of the land in the subdivision non-contributory to the street flow. This approach was used particularly in Unit 4 of Academy Hills and the conversion of the single family lots to townhouses is inconsistent with the fundamental design assumption just stated.

It is in the interest of the community that no runoff be allowed to bypass the storm sewer inlets and travel westward down Academy Rd. which has no other drainage facilities or provisions. I believe that you may also want to investigate further with staff the use or abuse of the summary plat and replat provisions of the Subdivision Ordinance by the surveyor and by the developer, in order to preserve the integrity and purpose of City government functions.

BC/fs

cc - Chuck Easterling