HYDROLOGY L2 3/D6 TWO PLANS

MEURER, SERAFINI AND MEURER, INC.

CONSULTING ENGINEERS • SURVEYORS • PLANNERS

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

October 16, 1978

Mr. Bruno Conegliano
City of Albuquerque
P. O. Box 1293
Albuquerque, New Mexico 87103

Subject: Drainage Concept - Four Hills Area

Dear Sir:

We would like to have your approval of the drainage concept which we intend to utilize in the development of the land located on the west side of Four Hills Road and south of the Tijeras Arroyo. The concept is shown on attachments "A" and "B".

If you have any questions regarding this matter, please advise.

Thank you.

Very truly yours,

MEURER, SERAFINI AND MEURER, INC.

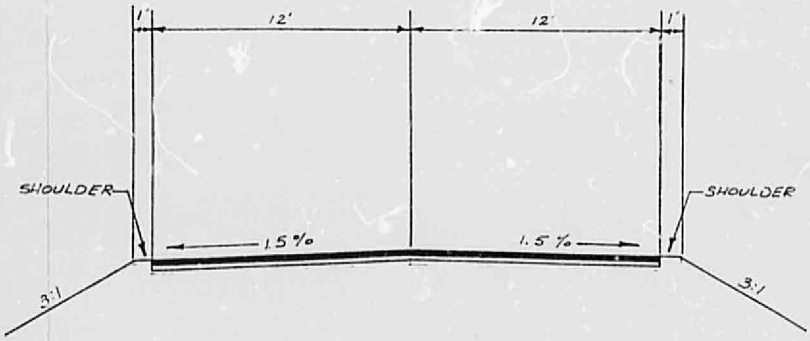
Robert Blanton

Robert Blanton, P.E.

RB:dw

Encl.

ATTACHMENT "B"



SECTION "A-A"
TYPICAL

NOT TO SCALE

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

October 18, 1978

Mr. Robert Blanton, P.E.
Meurer, Serafini and Meurer, Inc.
2601 Wyoming Blvd. N.E. Suite F
Albuquerque, New Mexico 87110

RE: DRAINAGE CONCEPT - FOUR HILLS AREA

Dear Mr. Blanton:

In reply to your letter dated 10/16/78, I am enclosing a copy of the description of the flood in Tijeras Canyon of August 5, 1895. The description fits the occurrence of a moving hydraulic jump discussed for instance on page 557 of "Open Channel Hydraulics" by Ven Te Chow.

In a major flooding occurrence, the flow in Tijeras Canyon would be a rapidly varying unsteady phenomenon, not, amenable to a simple evaluation and certainly not describeable by Manning's equation. That equation would probably provide an indication of a maximum velocity that could be experienced but its use in an energy balance process, to define the 100 yrs. water surface profile would not be appropriate.

Given the supercritical slope of the arroyo, minor variation in channel configuration (planimetric and longitudinal),bottom roughness or vegetative cover, would be sufficient to cause the flow to jump from supercritical to subcritical conditions. Flow instability of this nature would be manifested with standing waves and similar disturbances. Under these conditions, the water surface elevation could approach, in a discontinuous manner, the theoretical energy grade line which would be found as much as 10 ft. higher than the estimated supercritical flow depth.

I would also expect that a train of surges or bores would be observed during the rising limb of the hydrograph.

A further complication to the flow would result from the confluence of the contributions from the Tramway diversion channel in the same reach of the arroyo, possibly producing upstream surges.

In my opinion a serious error in judgement was committed when approval was granted for the establishment of the Hidden Valley Subdivision. I do not consider the hydraulic analysis submitted at that time, to have been adequate to represent the phenomena which would be observed in the arroyo in the event of a 100 yrs. flooding episode.

I will, therefore, not approve any further encroachment of the floodway nor development in the flood plain of Tijeras Canyon Arroyo without carefully engineered protection works. Model Studies performed at the hydraulic lab of the University will have to substantiate the validity of the protection works recommended and of the adequacy of the channels transitions under conditions of rapidly varying flows. The flows will have to simmulate the appropriate flood hydrographs for both the Tijeras Canyon Arroyo and the Tramway Channel.

Very Truly Yours,

Bruno Conegliano
Asst. City Engineer-Hydrology

BC/tl

cc: C. D. Sheppard, Acting City Eng
Richard Leonard, AMAFCA
Drainage file

RICHARD E. LEONARD
EXECUTIVE ENGINEER

B. H. SWINBURNE, CHAIRMAN
R. WARD HUNNICUTT, VICE-CHAIRMAN
FRANCES McCOY, SECRETARY-TREASURER
VERNON DOAK, DIRECTOR
KLESTON LAWS, DIRECTOR

Albuquerque
Metropolitan
Arroyo
Flood
Control
Authority

2600 PROSPECT AVE., N.E.
P. O. BOX 25851 · ALBUQUERQUE, N. M. 87125
TELEPHONE 884-2215

Bruce

FILE:
1. TIJERAS ARROYO
2. EXECUTIVE HILLS
3. AMAFCA CORRP.

L23-D6

March 10, 1981

Mr. Vern Hagen, Director
Planning Division
City of Albuquerque

Dear Vern:

We have recently exchanged correspondence concerning AMAFCA sign-off of summary plats. A current situation illustrates my frustration and our need to work closer.

Attached is a chronology of land-division plats for Executive Hills. This subdivision sits immediately west of Four Hills Road on Tijeras Arroyo and its floodway.

My principal concern is that the land was divided without a drainage easement or any acknowledgement of the arroyo. The most recent division occurred last month, just after our offices had worked together on the "Tijeras Arroyo Drainage Management Plan."

It also appears that the divisions of Tract 1A occurred in violation of time constraints imposed by the County Subdivision Ordinance. If this is so, please consider revoking the illegal plats.

You are probably weary of my carping; however, Executive Hills demonstrates how a developer can circumvent the system unless we work together. Let's discuss this some more.

Sincerely,

Rich Leonard

Richard E. Leonard
Executive Engineer

jc
Enc.
cc: Phil Garcia
John Lucero
J. Van Erven
R. Heller
B. Conegliano

INCLOSURE

EXECUTIVE HILLS SUMMARY PLATS

a. Summary Plat Executive Hills comprising Tracts 1, 2, 3 & 4 filed July 29, 1976.

b. Summary Plat Executive Hills Tracts 1-A, 2-A, 3-A and 4-A filed June 30, 1978 correcting Four Hills Road R.O.W. location.

c. Replat Executive Hills Tract 1-A now comprising Tracts 1-A-1, 1-A-2, 1-A-3 and 1-A-4 dated March 1979 filed April 2, 1979 signed by Mike Nennessy for G. Davenport.

d. Land Division Plat of Tract 1-A-1 of the Replat of Tract 1-A of Executive Hills dated 2/10/81 filed February 13, 1981 signed for VCH by John R. Lucero.

C.A. (PAT) COONCE & ASSOC.
ENVIRONMENTAL, WATER RESOURCES, & SANITARY CONSULTING ENGINEERS

12324 PINERIDGE, N.E.
ALBUQUERQUE, N.M. 87112

PHONE (505) 296-1089

→ C. Easterling
(for info)

April 7, 1981

Richard E. Leonard, P.E.
Albuquerque Metropolitan Arroyo Flood Control Authority
Post Office Box 25851
Albuquerque, New Mexico 87125

RE: EXECUTIVE HILLS

Dear Mr. Leonard:

Herewith submitted is a letter report for Executive Hills with the current flood potential conditions and with recommendations for interior protection until such time as the bridge on Four Hills road can be budgeted and built.

Sincerely,

C. A. Coonce

C. A. COONCE, P.E.
mls
encls.
cc: G. Veretto
F. Wilson

RECEIVED
APR 08 1981
CITY ENGINEER

RECEIVED
APR 07 1981
AMAFCA

FLOOD PROTECTION FOR EXECUTIVE HILLS

General:

The property addressed in this letter report is Executive Hills, located immediately South of Tijeras Arroyo and immediately West of Four Hills Road S.E. A portion of Tijeras Arroyo is contained within this tract of land.

Two reports have recently been completed by Bovay Engineering, Inc. for AMAFCA. One report was on Tijeras Arroyo in general and the most recent a specific look at the ROW needed for a bridge on Four Hills Road and channel improvements above and below the proposed bridge. Both reports use Corps of Engineers and City of Albuquerque data which are based on accepted practices and assumptions for hydrologic studies.

Current Conditions:

The Corps of Engineers 100 flood plain contour takes in all of the low lying area of this tract of land. However, the necessary and desirable public works in the vicinity have been to worsen the flood potential for this land. These are Four Hills Road and the East Diversion Channel. The design flow for the Four Hills Road could not be ascertained. This road was designed before the Corps of Engineers study. It may carry 10% of the 100 year flood flow. However, due to the nature of the channel upstream and the velocity it is likely that the entrances to the barrels would become clogged before maximum capacity could be achieved. This would necessitate an overflow of the road and a probably washout. This would inundate Executive Hills.

The nearly completed East diversion poses a possible threat to this tract. The flow must turn approximately 70° before lining up with a berm at 180

feet from the point of release at the outfall. The gradient in that direction is approximately the same as that in any other direction in the channel. This would indicate that there will be very little turning force until the berm acts as a deflector and adds the confining side force pressure. Added to this complication will be transverse waves which will induce the water to climb higher up the berm before stabilizing in the channel direction. It is believed that this berm cannot sustain this type of scouring action without failing. Figures 1 and 2 are the topos made of this area in mid-March 1981.

Recommendations:

It is believed that the most cost effective method for increasing the interim flood protection for this property are:

1. Provide a controlled overflow on Four Hills Road.
2. Strengthen and rip-rap the berm on the South side of Tijeras Arroyo where the East Diversion Channel may scour the berm.
3. Rotate the berm over which the private road traverses to a more southerly direction and increase its height as much as possible.

CITY OF ALBUQUERQUE

ALBUQUERQUE, NEW MEXICO

INTER-OFFICE CORRESPONDENCE July 21, 1981 REF. NO._____

TO: Bruno Conegliano, City Engineering Department

FROM: Anita P. Miller, Assistant City Attorney AM

SUBJECT: Proposed Settlement of AMAFCA v. Veretto, et al
No. CV-81-04534

On July 17, 1981, in the presence of Judge Gene E. Franchini, all of the parties agreed to the following settlement:

1. AMAFCA will bolster the dike at the mouth of the Tramway Diversion Channel.

2. AMAFCA will pay Veretto for the barn which is located in the floodplain.

3. Veretto will give an easement to the City/AMAFCA for the construction of a permanent drainage channel.

4. The angle of the channel will be changed, to enable the Verettos to retain more developable land.

5. Veretto will have the responsibility for engineering and building temporary protection at the Four Hills Road area.

   a. AMAFCA must approve the engineering design.

   b. There will be no occupancy of the house which is presently in construction, and which is the subject of this current lawsuit, until the structure is approved by AMAFCA.

   c. AMAFCA and Veretto will split the cost of the construction of the temporary protection at Four Hills Road.

I have not received a formal settlement agreement as yet, but assume that one is being drafted by the attorneys for the principal adversaries, Bill Kraemer for AMAFCA and Ed Threet for the Verettos. At such time as a formal settlement has been signed and filed with the Court, I will send you a copy for your files.

AM/mk

CITY OF ALBUQUERQUE

ALBUQUERQUE, NEW MEXICO

INTER-OFFICE CORRESPONDENCE July 22, 1981 REF. NO._____

TO: Anita Miller, Assistant City Attorney

FROM: Bruno Conegliano, Assistant Hydrology Engineer

SUBJECT: Proposed Settlement of AMAFCA Versus Veretto, No. CV-81-04534

Having reviewed your memo with the terms of the tentative agreement drafted by the attorneys in the referenced case, I have reached the conclusion that a dangerous precedent would be set by the consummation of that agreement with major adverse consequences for the community. My reasoning is as follows:

1. The City constructed the Tramway Diversion Channel using the utmost care and best engineering judgment. The leading hydraulic laboratory in the country, that of the Colorado State University in Ft. Collins, Colorado, was retained by the City to verify the design of the consultant for the project, Bohannan, Westman and Huston, Inc. The laboratory performed model studies and ascertained that the energy of the flood flows conveyed by the Tramway Channel would be completely dissipated within the engineered structure.

Consequently, the flood flows leaving the structure would not be injurious to the Tijeras Arroyo Channel nor to the adjacent properties. The design discharge of the Tramway Diversion Channel would be less than one-fourth of the 100 year flood flow in the arroyo itself. Further, storms of greater magnitude than the 100 year storm would not generate greater flows in the Tramway Diversion Channel since said flows would not be intercepted by the constructed facility. Said flows would rather continue westward along such major thoroughfares as the Interstate Highway 40, Copper Avenue, Lomas Avenue, etc.

2. In the event of a 100 year frequency storm, the existing crossing over the Tijeras Arroyo would, in the estimation of the U.S. Corps of Engineers, be overtopped by a flood wave with a depth of ten feet or more above the existing pavement of Four Hills Drive. (See attachment).

3. Neither the City nor AMAFCA are responsible for the construction and occupancy of the residences erected by Mr. Veretto notwithstanding specific contrary advice by the City, but the agreement would legitimize the existence of the structures and their habitation. Further, the liability for property damages and for the probable loss of life would be transferred from the builder to public agencies.

4. While it is the responsibility of the City to provide permanent access to the residents of the subdivisions to the south of the arroyo, neither the City nor AMAFCA have any need or obligation to

confine the flood flows of the arroyo in an engineered channel. On the contrary, according to existing development policies (1) the City cannot even consider requests for development in the floodplain of the Tijeras Arroyo. Such floodplain development is contrary to the specific advice and warning given to the City by the U. S. Corp of Engineers (letter from J. H. Coombes, P.E. dated February 29, 1980 attached) and to national policies (President Carter's EXECUTIVE ORDER 11198, dated 5-24-1977).

5. The consent agreement would irreversibly commit and compell public agencies to the provision of structural measures for the confinement of the flood flows of the Tijeras Arroyo. Said action would allow other developers to use this precedent as justification to expand the utilization and the occupancy of the floodplain to the west of Four Hills Dr., subverting the adopted policies mentioned in 4) above. .

6. As explained in the comments by this department to the recent application for Planning Action AX 81-18 (attached) the confinement of floodflows would have adverse consequences for the communities downstream from the confluence of the Tijeras Arroyo and the Rio Grande Also said channelization would cause the community terminal unneeded liabilities .The paradoxical nature of these proceedings is summarized as below:

A. AMAFCA initiated a legal action against the City, the County and Mr. Verreto because

a. Mr. Verreto had

1. Unlawfully encroached on the floodway of a major watercourse.

2. Circumvented the rules and procedures established by the local governments to insure the orderly and safe development of the community.

3. Constructed houses in violation of building codes and Federal Government Regulations with consequent exposure of the probable future home buyers to significant hazards to their lives and their possessions.

b. the County had failed in its fundamental obligation to insure the safety of its residents through the effective policing of building construction.

B. The draft agreement will have the following untoward consequences:

1. Land presently worthless, because in the path of the flood flows of the Tijeras Arroyo will be made whole and veluable at significant cost to the public.

2. Public agencies will absolve the developer from the liabilities he would incur by constructing and selling properties subject to inundation, in the full knowledge of the hazards; said agencies would also assume the liability for perpetual protection of the houses constructed abusively and for the lives of the residents.

(1) See Ref. (1) in enclosed planning action comment.

3. Public agencies would also assume liability for any additional homes that Mr. Veretto may construct on the remainder of his land.

4. The agreement would establish a legal precedent that would allow further encroachment of the floodplain of Tijeras Arroyo between Four Hills Road and the Rio Grande; such development would constitute a subversion and abrogation of existing policies and impose on the community additional liabilities for the protection of third parties.

5. The agreement would compel public agencies to assume perpetual maintenance obligations of the channelized arroyo, for which funds are unavailable today or in the foreseeable future.

6. Finally the agreement would quite likely increase the cost of the structure necessary to give allweather access to the development south of the arroyo.

7. No penalties or liabilities would accrue to the County notwithstanding its major share of the responsibility.

BC/fs
Enclosures

Flood routing program

This fourth article in the CE computing series presents a BASIC language program for routing floods through storage reservoirs or detention basins by the storage-indication working curve method (Modified Puls Method).

BERNARD L. GOLDING, P.E., M. ASCE.
Chief, Water Resources (South)
Howard Needles Tammen & Bergendoff
Orlando, Florida

MANY MUNICIPALITIES now require in their subdivision regulations that post-development runoff cannot exceed pre-development runoff for a particular frequency design flood. This is normally accomplished by the construction of a detention basin in the subdivision. The basin acts as a small flood control reservoir and attenuates the peak of the runoff hydrograph before it enters the receiving waters.

The only way the effect of the detention basin can be accurately determined is by flood routing the design inflow hydrograph through the storage in the basin. Formerly, the actual process of flood routing using hand computations was a time-consuming nuisance taking as long as two hours; now, with the microcomputer, it can be done in 15 minutes.

The program for doing flood routing subsequently described follows the general hand computation procedures for reservoir flood routing—utilizing the Storage-Indication Working Curve Method or Modified Puls Method. This procedure assumes that the outflow (discharge) from the basin is directly proportional to the storage in the basin. This program requires the same initial input information as required by hand computation: a rating curve for the outlet pipe or structure with discharge in cfs for each successively higher water surface elevation where the basin's water surface elevation is the head on the outlet pipe or structure; and an elevation-storage curve for the detention basin where storage is in acre-feet. Knowing these two relationships, the discharge in cfs and the storage in acre-feet at each discharge can be computed which is the actual input to the computer.

However, the program subsequently described can be easily modified to allow direct entrance of both the rating and storage curves thus eliminating the hand computation of the discharge-storage relationship. I also use this program to route major floods through large reservoirs.

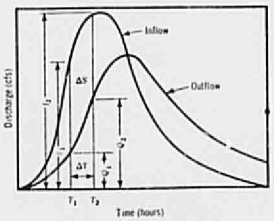


Figure 1. Derivation of storage equation.

Program description and methodology

In this program, flood routing is accomplished by the use of the standard flood routing equation (see Figure 1):

$$[I_1 + I_2/2]\Delta T - [Q_1 + Q_2/2]\Delta T = S_2 - S_1 = \Delta S \quad (1)$$

transposed to its storage-indication working curve format

$$I_1 + I_2/2 + S_1/\Delta T + Q_1/2 - Q_1 = S_2/\Delta T + Q_2/2 \quad (2)$$

In Equations 1 and 2:

I_1 and I_2 = inflow rates at times 1 and 2

Q_1 and Q_2 = outflow rates at times 1 and 2

S_1 and S_2 = storage values at times 1 and 2

ΔT = time$_1$ − time$_2$ (time interval)

In Equation 2, all known values are on the left side of the equation and the unknown values on the right side of the equation. Initially, I_1, Q_1 and S_1 are equal to zero such that: $I_2/2 = S_2/\Delta T + Q_2/2$.

Knowing $S_2/\Delta T + Q_2/2$, the storage-indication working curve value at each different charge, the value of Q_2 is solved by interpolation of the discharge-storage indication working curve values. Then Q_2 and $S_2/\Delta T + Q_2/2$ become Q_1 and $S_1/\Delta T + Q_1/2$ of the following time interval, ΔT, which permits the evaluation of the third discharge value, and so on.

Initial inputs to the computer are the inflow hydrograph ordinates entered as Data Statements in the program; the discharge and the storage at each discharge—the initial value of discharge and storage being generally assumed equal to zero; and the routing time interval. Dis-

Program variables

Q = T1(U,1)	Discharge value entered
ST = T1(U,2)	Storage value entered
T2	No. of discharge and storage values entered
T1(J,2)	Computed storage indication working curve values.
T	Time period (increment)
I1	Inflow at beginning of time period
I2	Inflow at end of time period—ordinates of inflow hydrograph
i3	Average inflow $(I_2+I_1)/2$
R	Computed value of $S1/\Delta t + O/2$
M	Computed slope of two successive discharge-storage indication working curve values.
B	Computed intercept on Y-axis of slope of two successive discharge-storage indication working curve values.
Q1 = Q3	Computed outflow value
V	Ordinate between inflow and outflow hydrograph at a particular time
V1	Sum of ordinates between inflow and outflow values.
V2	Volume between inflow and outflow hydrographs (maximum volume stored in detention basin or reservoir).

0360-0556/81/0006-0074/$01.00

```
100 PRINT 'FLOOD ROUTING'
110 PRINT
120 PRINT '-------------'
130 PRINT
140 PRINT 'INPUT IMPOUNDMENT NAME  '
150 INPUT N$
160 DIM T1(60,2)
170 T2=0
180 PRINT
190 PRINT 'NOTE: SEPERATE DATA ITEMS REQUESTED WITH COMMAS '
200 PRINT 'NOTE: ENTER A VALUE OF -1,-1 TO END DATE ENTRY'
210 PRINT 'ENTER  DISCHARGE(cfs), STORAGE(acft) '
220 INPUT Q,S1
230 T2=T2+1
240 T1(T2,1)=Q
250 T1(T2,2)=S1
260 IF Q<>-1 THEN 210
270 IF S1<>-1 THEN 210
280 T2=T2-1
290 PRINT
300 PRINT 'INPUT TIME INCREMENT (hrs.) '
310 INPUT T
320 PRINT
330 PRINT 'DISCHARGE(cfs)     STORAGE(acft)'
340 PRINT '-------------------- ----------'
350 PRINT
360 FOR I=1 TO T2
370 PRINT T1(I,1),T1(I,2)
380 NEXT I
390 PRINT
400 FOR J=1 TO T2
410 T1(J,2)=T1(J,2)*12.1/T
420 T1(J,2)=T1(J,2)+T1(J,2)/2
430 NEXT J
440 PRINT
450 PRINT 'DISCHARGE(cfs)      S/T+O/2'
460 PRINT '-------------------------'
470 PRINT
480 FOR R=1 TO T2
490 PRINT T1(R,1),T1(R,2)
500 NEXT R
510 T9=0
520 V1=0
530 I1=0
540 S6=0
550 O=0
560 O6=0
570 PRINT
580 PRINT 'T (hrs.)      INFLOW (cfs)       OUTFLOW (cfs)'
590 PRINT '--------      ------------       -------------'
600 PRINT
610 READ I2
620 IF I2=-1 THEN 960
630 I3=(I1+I2)/2
640 R=S6+I3
650 S2=R-O6
660 FOR U=1 TO T2
670 IF S2<T1(U,2) THEN 690
680 NEXT U
690 M=(T1(U,1)-T1(U-1,1))/(T1(U,2)-T1(U-1,2))
700 B=T1(U,1)-M*T1(U,2)
710 Q1=M*S2+B
720 I1=I2
730 O3=Q1
740 O6=Q1
750 S6=S2
760 V=I2-O3
770 IF O3=>I1 THEN 800
780 V1=V1+V
790 REM ROUND OFF
800 O3=INT(O3*10+0.5)/10
810 REM ROUND OFF
820 I2=INT(I2*10+0.5)/10
830 PRINT T9,I2,O3
840 REMARK---INFLOW HYDROGRAPH INFORMATION IS CONTAINED
850 REMARK---IN THE DATA STATEMENTS BELOW. CHANGE THESE
860 REMARK---STATEMENTS TO REFLECT 'YOUR' REQUIREMENTS.
870 DATA 0,1.3,5.6,10.5,14.5
880 DATA 17.7,20.6,24,38.6
890 DATA 137.1,259.4,267
900 DATA 199.4,141.5,101
910 DATA 75.6,58.2,46.7,38.4
920 DATA 32.2,28.5,26,24.4
930 DATA 23.4,22.6,18,-1
940 T9=T9+T
950 GO TO 610
960 PRINT
970 V2=V1*T*(3600/43560)
980 REM ROUND OFF
990 V2=INT(V2*10+0.5)/10
1000 PRINT 'VOLUME STORED  = 'V2*'(acft)'
1010 END
```

```
FLOOD ROUTING
-------------
INPUT IMPOUNDMENT NAME  BRAD RESERVOIR

NOTE: SEPERATE DATA ITEMS REQUESTED WITH COMMAS
NOTE: ENTER A VALUE OF -1,-1 TO END DATE ENTRY
ENTER  DISCHARGE(cfs), STORAGE(acft)   0.00, 0.00
ENTER  DISCHARGE(cfs), STORAGE(acft)   4.24, 14.40
ENTER  DISCHARGE(cfs), STORAGE(acft)  12.00, 28.80
ENTER  DISCHARGE(cfs), STORAGE(acft)  51.71, 43.20
ENTER  DISCHARGE(cfs), STORAGE(acft) 114.67, 57.60
ENTER  DISCHARGE(cfs), STORAGE(acft) 186.81, 72.00
ENTER  DISCHARGE(cfs), STORAGE(acft) 243.19, 86.40
ENTER  DISCHARGE(cfs), STORAGE(acft)  -1.00, -1.00

INPUT TIME INCREMENT (hrs.) 1.00

DISCHARGE(cfs)     STORAGE(acft)
---------------    -------------

0                  0
4.24               14.4
12                 28.8
51.71              43.2
114.67             57.6
186.81             72
243.19             86.4


DISCHARGE(cfs)     S/T+O/2
---------------    -------

0                  0
4.24               176.36
12                 354.48
51.71              548.575
114.67             734.295
186.81             914.405
243.19             1177.035

T (hrs.)     INFLOW (cfs)     OUTFLOW (cfs)
--------     ------------     -------------

0                0                0
1                1.3              0
2                5.6              0.1
3                10.5             0.3
4                14.5             0.6
5                17.7             1
6                20.6             1.4
7                24               1.9
8                38.6             2.6
9                137.1            5
10               259.4            10.6
11               267              22
12               199.4            175.1
13               141.5            141.3
14               101              134.4
15               75.6             118.6
16               58.2             102.4
17               46.7             87.1
18               38.4             73.5
19               32.2             61.8
20               28.5             52.2
21               26               46.9
22               24.4             42.5
23               23.4             38.7
24               22.6             35.5
25               18               32.4

VOLUME STORED  = 27.4
```

charge must be in cubic feet per second (cfs), storage at each discharge in acre-feet and the routing time interval in hours.

In the program, the storage indication working curve values at each discharge are first computed which enables the solution of Equation 2. In solving for the resultant discharge at each inflow value, the program makes a straight line interpolation of the discharge-storage indication working curve values at the desired discharge.

Program description

In the first part of the program, Lines 190-380, the discharges in cfs T1(T2,1) = Q and the storage in acre-feet T1(T2,2) = S1 at each discharge are entered into the program and listed for checking purposes. In the second part of the program, Lines 400-500, the storage indication working curve values T1(J,2) in cfs-hours are computed (1 acre-foot = 12.1 cfs-hours) and listed. In the third part of the program, Lines 610-650, which is the actual flood routing portion of the program, the inflow I2 at each time interval T is read and the storage indication value is computed. In the subsequent portions of the program, the discharge value Q1 at each value of S2 is computed by comparing the various values of T1(U,2) until S2 is less than one of them (Lines 660-680). When this occurs, the program computes the slope of the straight line using Line 690.

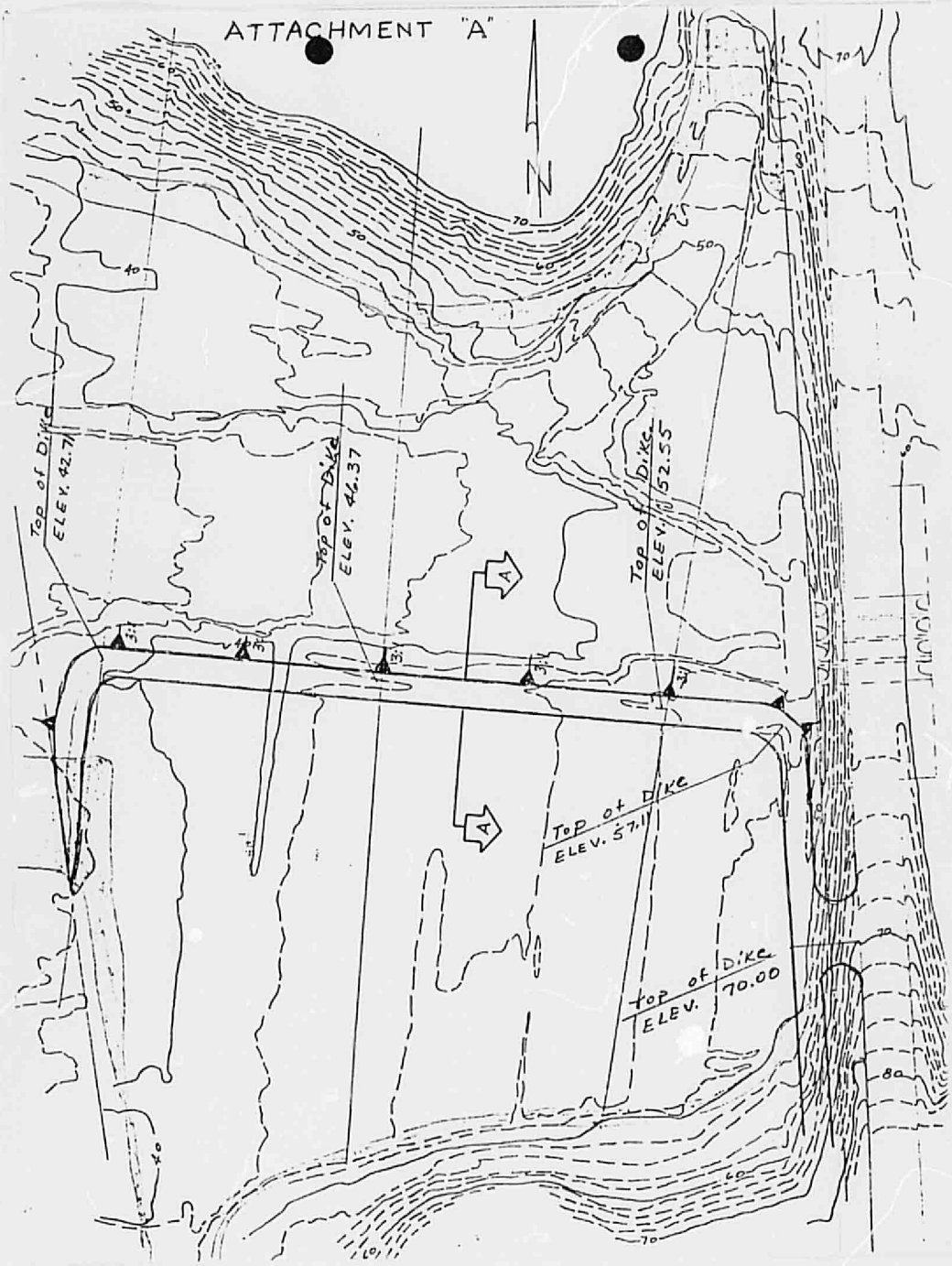
The intercept on the Y-axis, b, is then computed by Line 700 and then Q1 is determined in Line 710 using the slope intercept equation $y = mx + b$. The time T9 and outflow discharge at the particular time are then printed. In Line 720, the inflow at the end of the particular time T9 is made equal to the inflow at the start of the subsequent time period.

Example execution

The sample execution shown in the box indicates all necessary input to route a typical inflow hydrograph through the Brad Creek Reservoir. Discharge through the reservoir outlet structure (in cfs) and storage (in acre-ft) at each discharge are determined and printed using a user specified routing time of one hour.

Bernard L. Golding has over 30 years in water resources, hydrology and hydraulics. He has written computer programs in these fields and recently published a book, "Practical BASIC Language Programs in Hydrology and Hydraulics Engineering." He is working on the design of a new emergency spillway for the Lake Manatee Dam, Bradenton, Florida.

ATTACHMENT "A"



EDMUND PITT ROSS

NEW MEXICO REGISTERED PROFESSIONAL ENGINEER
AND LAND SURVEYOR NO. 1274

430 DARTMOUTH DRIVE, N.E.
ALBUQUERQUE, NEW MEXICO

DRAINAGE REPORT

Pertaining to portions of LOS CERROS SUBDIVISION
Northeast Albuquerque, New Mexico,
within the Northwest Quarter of the
Northwest Quarter of Section Twenty-six (26)
of Township Ten (10) North, Range Four (4) East
of the New Mexico Principal Meridian.

Map key: L-23-Z (Albuquerque Planning Department)

CERTIFICATION

I hereby certify that the included Drainage Report was prepared by me, that the data contained herein is true and correct to the best of my knowledge and belief, that I have personally inspected the site; and that no grading, filling or excavating has occured since contour maps were made. Witness my hand and seal this 1st day of April, 1973. Edmund Pitt Ross

GENERAL CONDITIONS

The subject property falls within a partially developed residential district adjacent to the northwest portion of the I-40 (Coronado Freeway) and U.S.66 (Central Avenue) interchange and lies on the alluvial fan abutting the west slope of the Sandia Mountains, being within the northern watershed of the Tijeras Canyon Arroyo. The natural character of the terrain is sandy-loam soil with sparse grass cover. No major drainages cross the property. Surface runoff follows five concentration alinements running from northeast to southwest across the site. All surface runoff ultimately drains to the Tijeras Canyon Arroyo approximately one-half mile south of the site through two drainage structures under the said Freeway. Refer further to Exhibits as attached.

GENERAL CONCLUSIONS SUMMARY

Most of the runoff from the drainages originally crossing the site have been (or, upon completion of current development, will be) intercepted and/or diverted and dispersed off-site;

The carrying capacities of the on-site streets as designed are adequate for anticipated runoff from a "100 yr." storm;

With complete development of each building site within the subject property to include normal drainage swales no danger should exist.

Refer further to Exhibits as attached.

SUPPLEMENTARY INFORMATION

Planning Department identification numbers: S-72-9; Z-72-54; V-72-11
Date originally considered by Planning Commission: 21 March 1972.
Name / address of developer: Robert Bowers (et al)/120 Virginia NE 87108

STATE OF NEW MEXICO COUNTY OF BERNALILLO

IN THE DISTRICT COURT

ALBUQUERQUE METROPOLITAN
ARROYO FLOOD CONTROL AUTHORITY
(AMAFCA), a political subdivision
of the State of New Mexico,

Plaintiffs,

vs. No. CV-81-04534

DONALD VERETTO, JOHN R. VERETTO,
MARILENE N. VERETTO, GLENN H.
VERETTO, BERNALILLO COUNTY, NEW MEXICO,
a politicial subdivision of the State
of New Mexico and THE CITY OF
ALBUQUERQUE, a municipal corporation
of the State of New Mexico,

Defendants.

A F F I D A V I T

STATE OF NEW MEXICO)
) ss.
COUNTY OF BERNALILLO)

Bruno Conegliano, upon his oath, and after having been duly sworn, states:

1. I am Assistant Hydrology Engineer of the City of Albuquerque and, in this capacity, have studied the Tijeras Arroyo Floodplain.

2. The City constructed the Tramway Diversion Channel using the utmost care and best engineering judgment. The leading hydraulic laboratory in the country, that of the Colorado State University in Ft. Collins, Colorado, was retained by the City to verify the design of the consultant for the project, Bohannan, Westman and Huston, Inc. The laboratory performed model studies and ascertained that the energy for the flood flows conveyed by the Tramway Channel would be completely dissipated within the engineered structure. Consequently, the flood flows leaving the structure would not be injurious to the Tijeras Arroyo Channel nor to the adjacent properties. The design discharge of the Tramway Diversion Channel would be less than one-fourth of the 100 year flood flow in the arroyo

itself. Further, storms of greater magnitude than the 100 year storm would not generate greater flows in the Tramway Diversion Channel since said flows would not be intercepted by the constructed facility. Said flows would rather continue westward along such major thoroughfares as the Interstate Highway 40, Copper Avenue, Lomas Avenue, etc.

3. In the event of a 100 year frequency storm, the existing crossing over the Tijeras Arroyo would, in the estimation of the U. S. Corps of Engineers, be overtopped by a flood wave with a depth of eight feet or more above the existing pavement of Four Hills Drive. (See attachment, Exhibit "A".)

4. While it is the responsibility of the City to provide permanent access to the residents of the subdivisions to the south of the arroyo, neither the City nor AMAFCA have any need or obligation to confine the flood flows of the arroyo in an engineered channel. On the contrary, according to existing development policies, the City cannot even consider requests for development in the floodplain of the Tijeras Arroyo. Such floodplain development is contrary to the specific advice and warning given to the City by the U. S. Corps of Engineers (see letter from J. H. Coombes, P. E., dated February 29, 1980, attached hereto as Exhibit "B"), and to national policies (President Carter's EXECUTIVE ORDER 11198 dated 5-24-1977, attached hereto as Exhibit "C".)

5. As explained in the comments of my department on the recent application for Planning Action AX 81-18 (attached hereto as Exhibit "D"), the confinement of floodflows would have adverse consequences for the communities downstream from the confluence of the Tijeras Arroyo and the Rio Grande. Also said channelization would cause the community terminal unneeded liabilities.

6. In my opinion, as a hydrology engineer, construction of a permanent drainage channel will have the following untoward consequences:

a. Land presently worthless, because in the path of the flood flows of the Tijeras Arroyo, will be made whole and valuable at significant cost to the public.

b. Public agencies will absolve the developer from the liabilities he would incur by constructing and selling properties subject to inundation, in the full knowledge of the hazards; said agencies would also assume the liability for perpetual protection of the houses constructed abusively and for the lives of the residents. (See reference (1) in Planning action comment Exhibit "D".)

c. Public agencies would also assume liability for any additional homes that Mr. Veretto may construct on the remainder of his land.

FURTHER AFFIANT SAYETH NOT.

Bruno Conegliano

SUBSCRIBED AND SWORN TO BEFORE Me this 30th day of July, 1981.

Notary Public

My Commission Expires:

1983