

DRAINAGE INFORMATION SHEET

APPLICANT'S NAME: Byals Engineering ZONE ATLAS/DRNG. FILE #: 14-23-1013

DRB #: N/A EPC #: N/A WORK ORDER #: _____

LEGAL DESCRIPTION: Parcel A, Tract 4 Lands of 4-Hills Sub 11/19/90 11/19/97 Installment

CITY ADDRESS: 5301 Central

ENGINEERING FIRM: Byals Eng

ADDRESS: 5301 Central

OWNER: Ken Johnson

ADDRESS: 1124 Monte Largo

ARCHITECT: _____

ADDRESS: _____

SURVEYOR: _____

ADDRESS: _____

CONTRACTOR: _____

ADDRESS: _____

TYPE OF SUBMITTAL:

☐ DRAINAGE REPORT

☒ DRAINAGE PLAN

☒ CONCEPTUAL GRADING & DRAINAGE PLAN

☐ GRADING PLAN

☐ EROSION CONTROL PLAN

☒ ENGINEER'S CERTIFICATION

☒ OTHER Letter of Response to

PRE-DESIGN MEETING: provided comments

☐ YES

☐ NO

☐ COPY PROVIDED

CHECK TYPE OF APPROVAL SOUGHT:

☐ SKETCH PLAT APPROVAL

☐ PRELIMINARY PLAT APPROVAL

☐ S. DEV. PLAN FOR SUB'D APPROVAL

☐ S. DEV. PLAN FOR BLDG. PERMIT APPROVAL

☐ SECTOR PLAN APPROVAL

☐ FINAL PLAT APPROVAL

☐ FOUNDATION PERMIT APPROVAL

☐ BUILDING PERMIT APPROVAL

☐ CERTIFICATE OF OCCUPANCY APPROVAL

☐ GRADING PERMIT APPROVAL

☐ PAVING PERMIT APPROVAL

☐ S.A.D. DRAINAGE REPORT

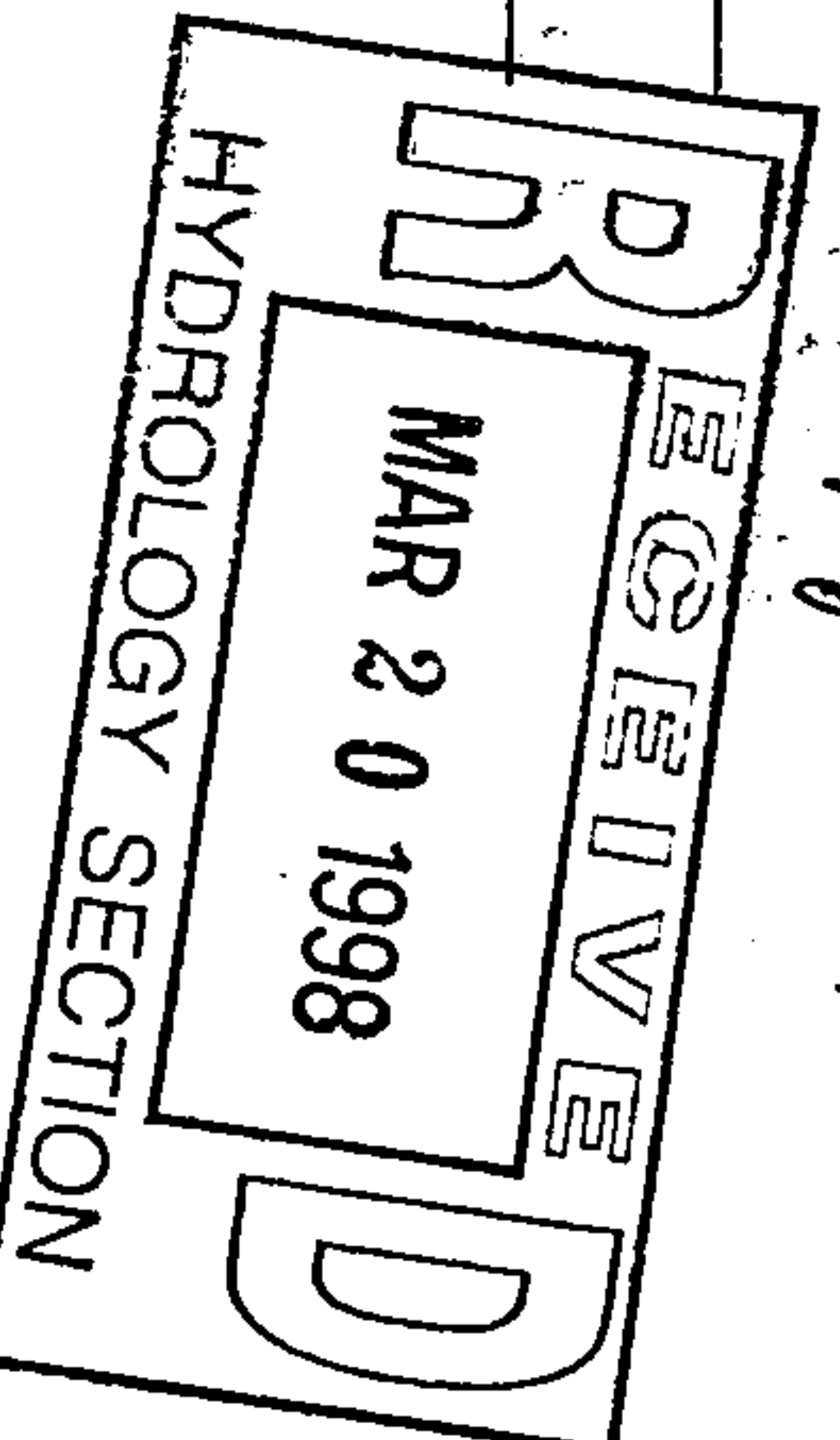
☐ DRAINAGE REQUIREMENTS

☒ SUBDIVISION CERTIFICATION

☐ OTHER Water Order (SPECIFY)

DATE SUBMITTED: 3-20-98

BY: Bill Byal



RYALS

engineering & construction services

5301 Central Ave. NE • Suite 913 • Albuquerque, New Mexico 87108
(505) 256-4701

March 20, 1998

Ms Lisa Manwell, P.E.
Hydrology Section
Public Works Department
City of Albuquerque
P.O. Box 1293
Albuquerque, N.M. 87102

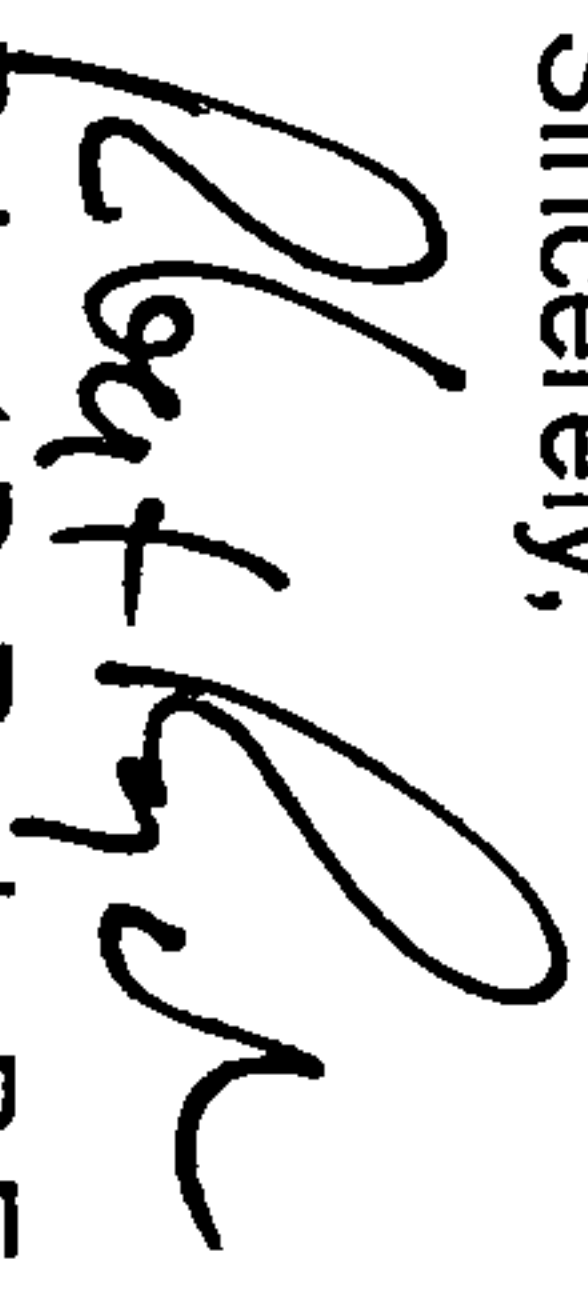
**RE: RON JOHNSON ACCESS ROAD (M23-D13), DRAINAGE REPORT FOR
GRADING AND PAVING PERMIT APPROVALS. LETTER DATED SEPTEMBER 30,
1997.**

Dear Ms. Manwell:

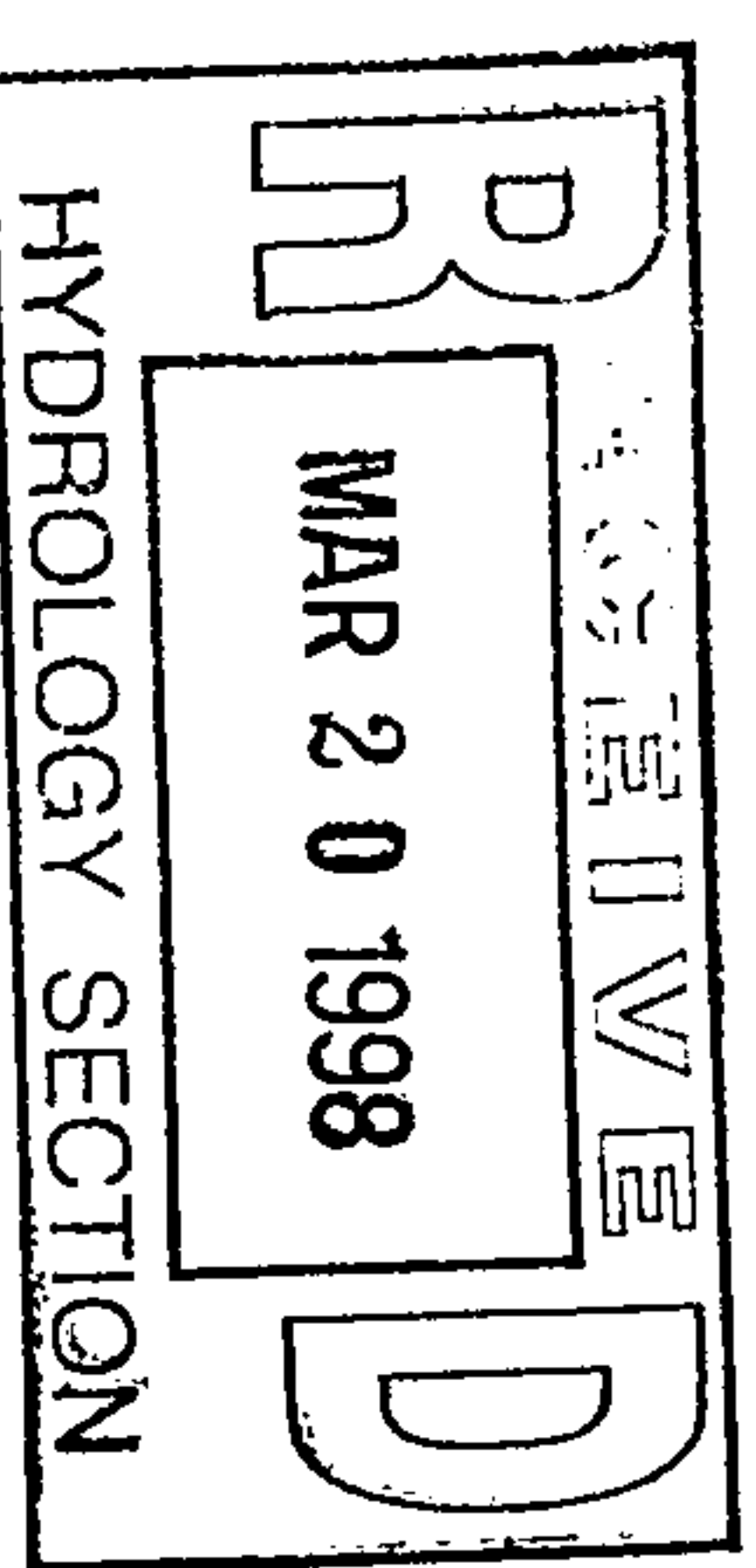
This letter is in reply to your letter providing comments to the referenced project, dated 9/30/97.

1. Sheet 4 of 4 has been revised, showing an updated section matching callouts on plan and profile sheets. Please find a copy of the new sheet 4 of 4 accompanying this letter.
2. As stated in the drainage report, the hydrologic parameters used for sizing the road crossing structure are based on undeveloped contributing watersheds. Plans for development of these areas do not exist. Future development should be controlled such that the runoff does not exceed the capacity of this culvert.

Sincerely,


Robert B. Ryals, P.E.

cc: John Castillo-Asst. Public Works Director
Billy Goolsby-DRC Chairman
Kevin Broderick-Transportation





September 30, 1997

Martin J. Chávez, Mayor

Robert Ryals, P.E.
Ryals Engineering
5301 Central NE
Suite 913
Albuquerque, NM 87108

**RE: RON JOHNSON ACCESS ROAD (M23-D13). DRAINAGE REPORT FOR
GRADING AND PAVING PERMIT APPROVALS. ENGINEER'S STAMP DATED
SEPTEMBER 2, 1997.**

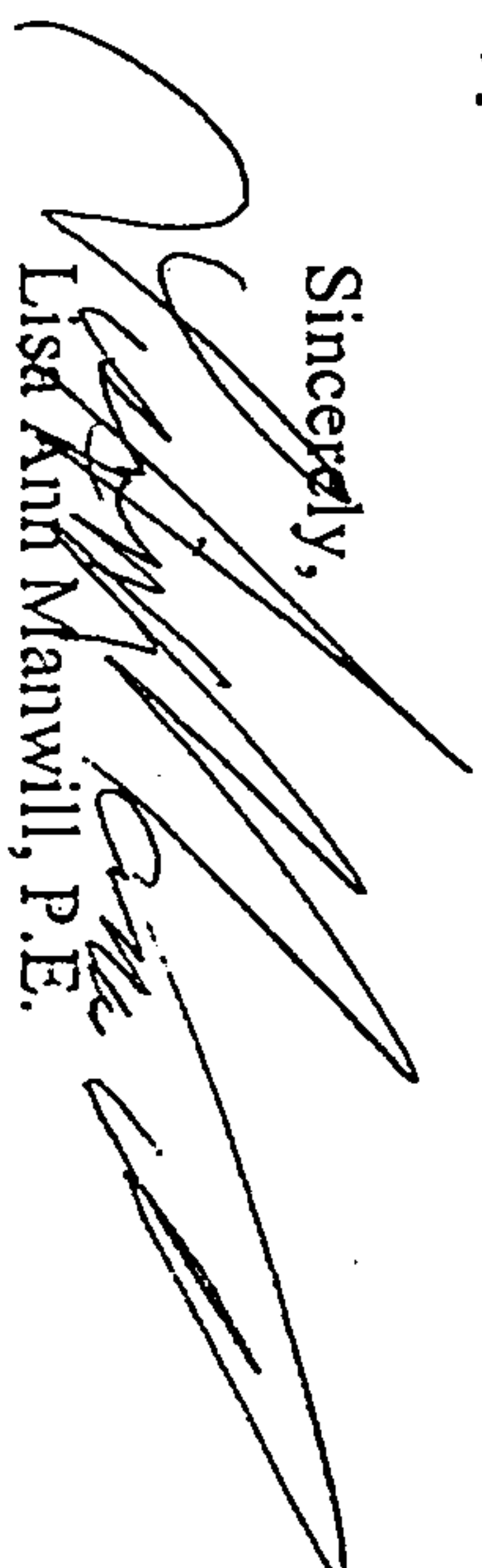
Dear Mr. Ryals:

Based on the information provided on your September 2, 1997 submittal, City Hydrology has the following comments:

1. Sheet 4 of 4, Section A-A shows a 95 foot RCP pipe for the culvert. Please updated the section to show the three 3-foot X 6-foot box culverts.
2. What happens north of where the road ends? Is this area ever going to be subdivided or developed? If so, you should design the street to accept the flow from this area. If the street is not designed for future flows, cross lot drainage easements with associated concrete swales will be required.

If I can be of further assistance, please feel free to contact me at 924-3984.

Sincerely,

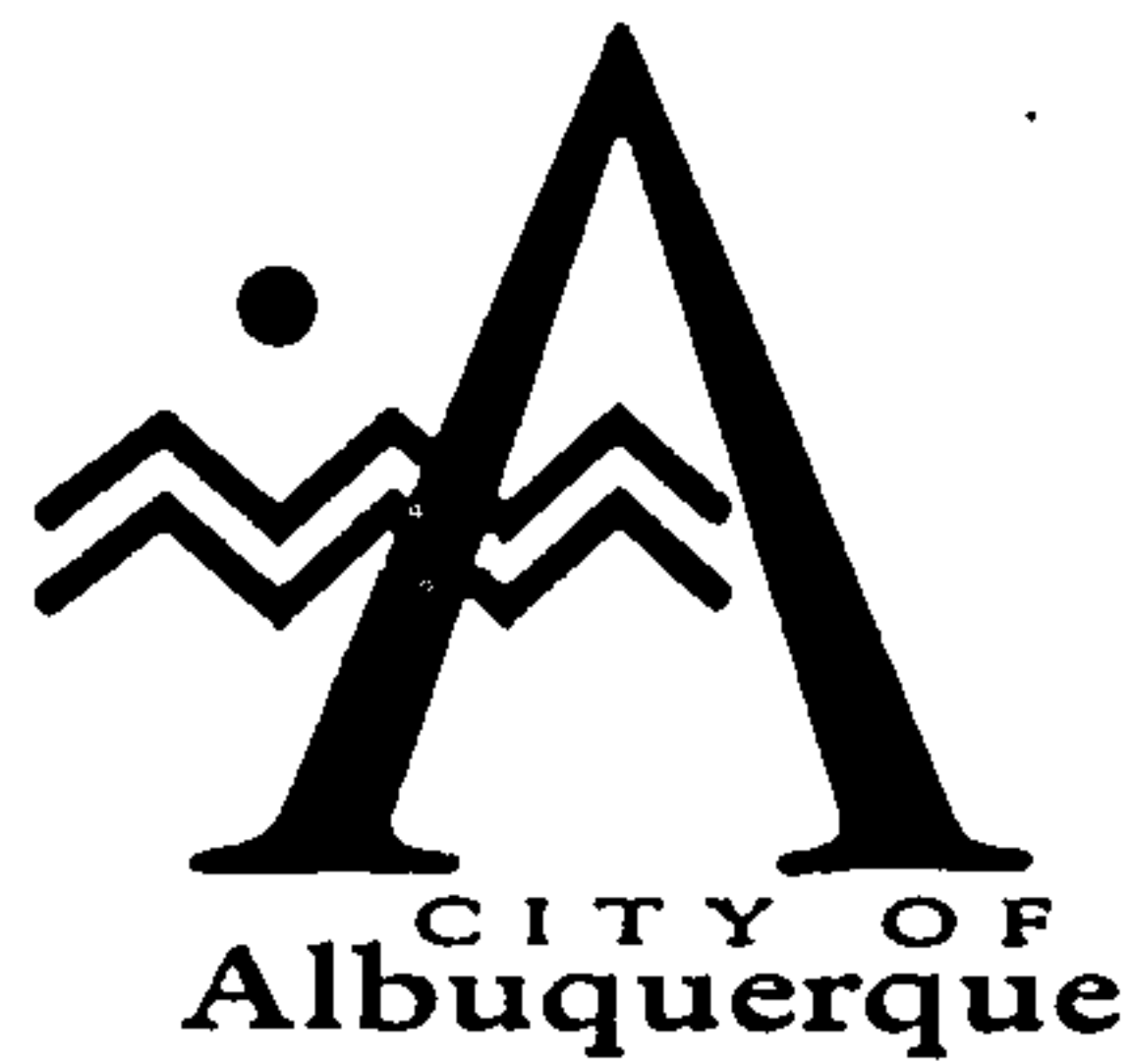

Lisa Ann Manwill, P.E.
Hydrology

c: Andrew Garcia

 File

Good for You, Albuquerque!





March 26, 1998

Robert Ryals, P.E.
Ryals Engineering
5301 Central NE
Suite 913
Albuquerque, NM 87108

**RE: RON JOHNSON ACCESS ROAD (M23-D13). GRADING AND DRAINAGE PLAN
FOR GRADING, PAVING AND WORK ORDER PERMIT APPROVALS.
ENGINEER'S STAMP DATED MARCH 19, 1998.**

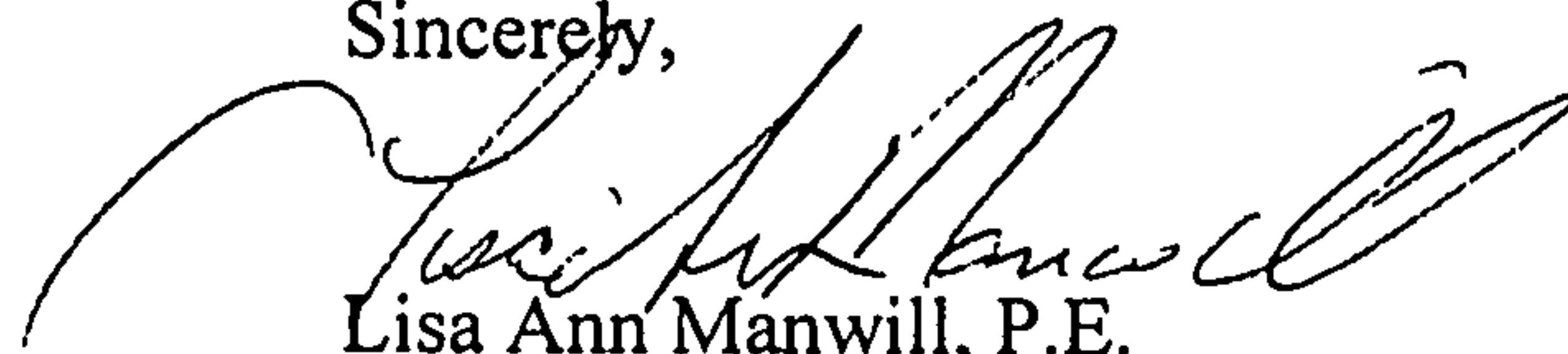
Dear Mr. Ryals:

Based on the information provided on your September 2, 1997 submittal, the above referenced project is approved for Grading, Paving, and Work Order Permits.

An Engineer's Certification will be required prior to release of Financial Guarantees.

If I can be of further assistance, please feel free to contact me at 924-3984.

Sincerely,



Lisa Ann Manwill, P.E.
Hydrology

c: Andrew Garcia
~~File~~

Good for You, Albuquerque!



**DRAINAGE REPORT
FOR
RON JOHNSON PRIVATE ACCESS ROAD
FOUR HILLS VILLAGE
CITY OF ALBUQUERQUE**

Prepared for
Ron Johnson
1124 Monte Largo N.E.
Albuquerque, New Mexico 87108

Prepared by:
Ryals Engineering and Constructors Services Co.
5301 Central N.E., Suite 913
Albuquerque, N.M. 87108

Robert B. Ryals, P.E.

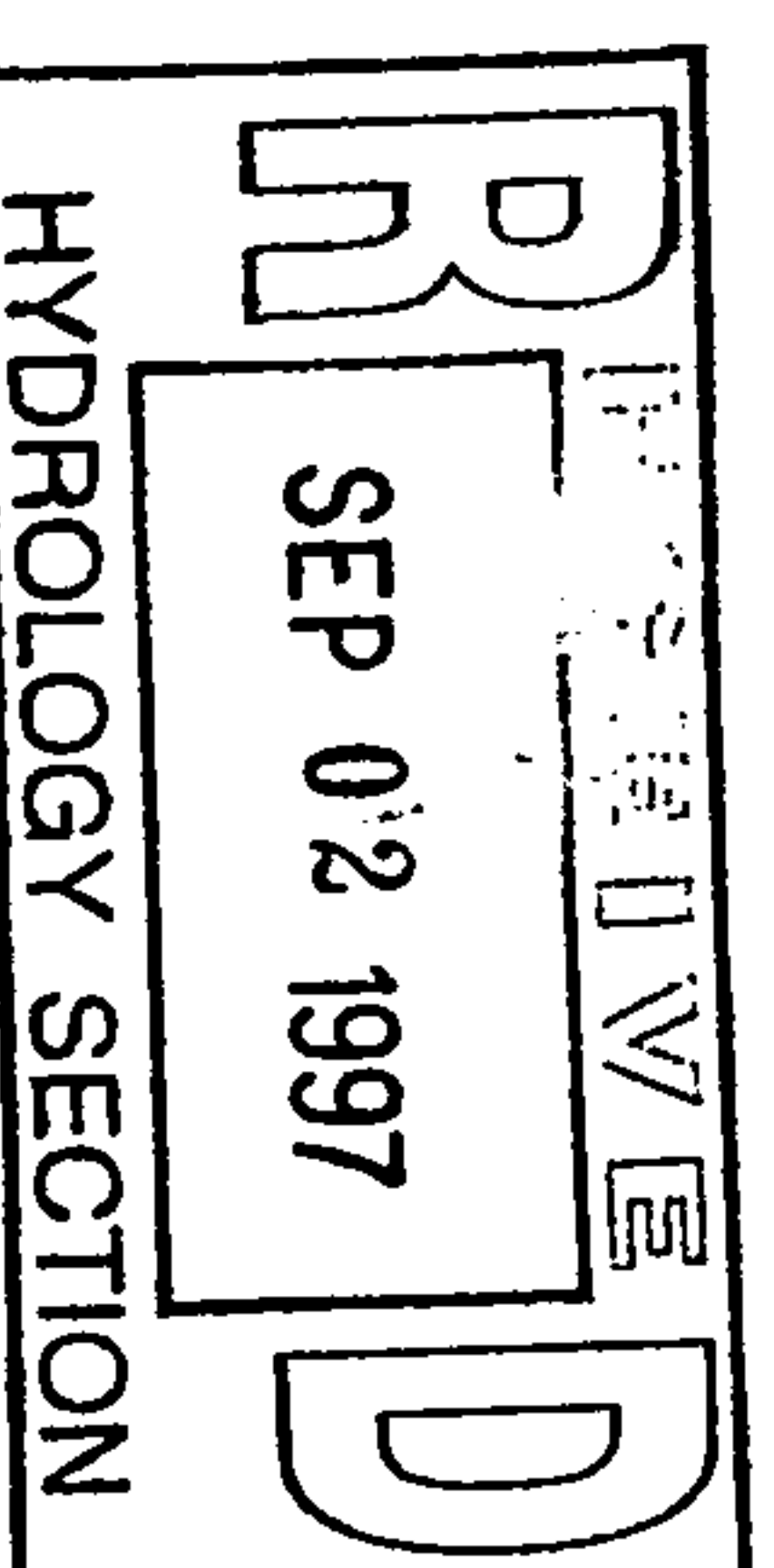
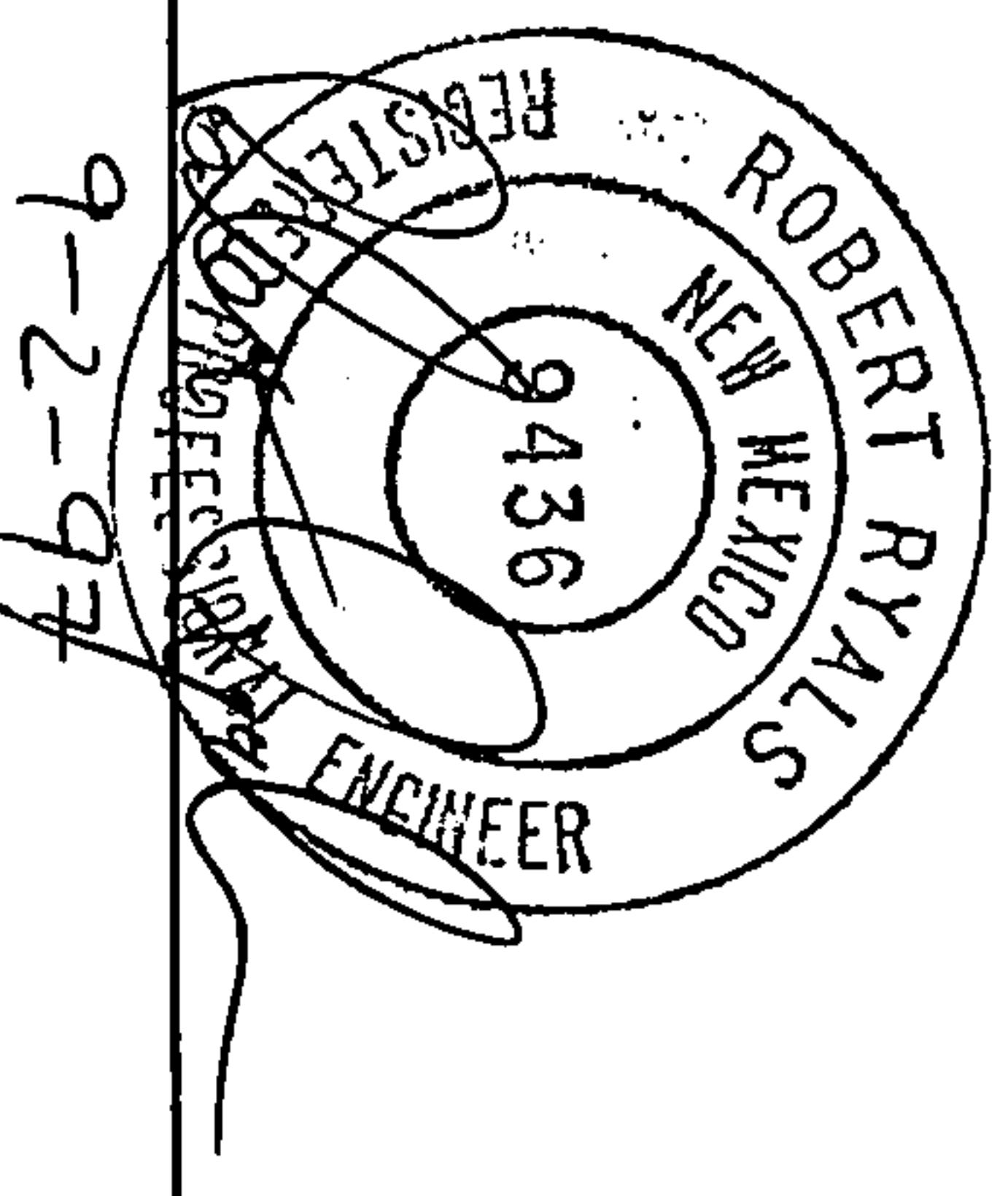


TABLE OF CONTENTS

DRAINAGE REPORT

Introduction
Existing Conditions
Developed Conditions
Recommendations
Table I - Revised Hydrology

APPENDIX 1

Layout & HEC-2 Stationing - Fig 1
HEC-2 Cross Sections-Case A - Fig 2
(Case C similar)
Existing & AAR design cross sections - Fig 3
HEC-2 Run - Case A
HEC-2 Run - Case C

APPENDIX 2

Drainage Report for Four Hills Village 18th
Installment, Dated November 1978, by
Andrews, Asbury & Robert, Inc.

EXHIBITS

1. Plat Map of Study Area
2. Drainage Analysis of Developed Additions
3. Paving Plan and Profile Drawing
4. Detail sheet

**DRAINAGE REPORT
FOR
RON JOHNSON ACCESS ROAD
FOUR HILLS VILLAGE
CITY OF ALBUQUERQUE**

Prepared by Ryals Engineering and Construction Service Company

January 23, 1996

Revised April 25, 1997

Revised September 2, 1997

INTRODUCTION

Mr. Ron Johnson proposes building a public road along a public right-of-way within the 11th Installment of Four Hills Village in the extreme southeast quadrant of the City of Albuquerque (City Zone Map M23). The plat for the study area is contained in Exhibit No. 1. The proposed road will cross over the Four Hills Diversion Channel at the right-of-way of Stagecoach Road. The road will then follow the La Cabra Drive right-of-way east to the municipal boundary. This road is needed to access unplatted property owned by Mr. Johnson.

No subdivision of the property to be served by the access road is currently proposed. Future development of this property will have to ensure that runoff from it does not result in exceeding the capacity of the diversion channel.

This report presents the storm drainage analysis done to determine the size and quantity of culverts needed to safely pass the 100-year frequency flood flow at the access road crossing of the diversion channel.

EXISTING CONDITIONS

The basis for this report is a drainage report prepared in November 1978 by Andrews, Asbury & Robert, Inc. (AAR) for Paul's Homes, Inc. of Albuquerque. This report is enclosed as Appendix No. 2.

Briefly summarizing the AAR report, a development company, Paul's Homes, wanted to develop land for a subdivision within Four Hills Village, 19th Installment. AAR analyzed both onsite and offsite drainage in the vicinity of the proposed subdivision. Offsite drainage (see exhibit #2) included runoff into the future Four Hills Diversion Channel. Subbasins D-3 through D-8 delineated in that report form the watershed that generates all the runoff into the diversion channel at the location of the proposed access road crossing. In the AAR report, sub basins D3 through D8 are analyzed as undeveloped land.

September 2, 1997 (2:50pm)

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Subbasins D-3 through D-8 are characterized by soil uncompacted by human activity on slopes of 10-20 percent. These subbasins have remained relatively undisturbed since the AAR report was prepared. Therefore, the hydrologic analysis performed for this study only updates the analysis presented in the AAR report in order to be in conformance with the current City of Albuquerque, DPM standards (Section 22.2-2, January 1993).

Table 1 presents the results of the 100-year flood frequency by subbasin. The total discharge calculated for the 71.8 acre drainage area was 186.7 cfs. The AAR report had calculated a total discharge of 179.5 cfs. The new analysis is for several small basins by the DPM simple method for small watersheds, with the results simply added. An AHYMO analysis (instead of the simple method) would probably have yielded a smaller peak discharge, partly because of differences in methodology and partly because of routing and time of concentration effects.

The Four Hills Diversion Channel intercepts major runoff flows east of the Four Hills Village. The channel, which directs the flow in a southerly direction toward the Four Hills Arroyo, is approximately 2,800 feet long and runs from north to south. The western side of the ditch, which protects Four Hills Village, has a berm of 4 feet in height and a top width of 12 to 15 feet. The eastern side does not have a berm. The channel and the land to east side are designated as Open Space.

In the AAR report design, the improved channel, at the location of the access road, has a bottom width of 12 feet, 4H:1V side slopes, longitudinal slope of 0.25% and roughness $n = 0.030$. In conjunction with this project, several channel sections up and downstream of the Stagecoach road right-of-way were surveyed. Typically, these channel sections had side slopes of 3:1, depths of 4 feet from flowline to top of berm, and bottom widths that varied from 12 to 20 feet. The average channel slope was approximately 0.25%. Based on site inspection Manning's n is approximately 0.035.

DEVELOPED CONDITIONS

The access road will have a City of Albuquerque standard residential paving section, 24 feet from face of curb to face of curb, standard 8" curb and gutter, with asphalt paving 3 inches thick. The crossing structure at the channel will be a set of culverts as discussed below. The culverts will be located approximately 160 ft from the existing end of paving in Stagecoach Rd. The minor amount of runoff originating on this part of the paving will flow onto the existing pavement in Stagecoach.

The road will extend approximately 800 ft upstream of the culverts. The peak runoff from this portion of the 60 ft right of way (assuming the 25.25 ft paving section as impervious and the rest as Treatment C) is approximately 4.53 cfs. Of this, about 2.33 cfs originates on the paving and will be conveyed to the channel by the rundowns shown on the plans.

September 2, 1997 (2:51pm)

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The culverts selected are 3 side-by-side concrete box culverts (CBC's), each 6 ft wide by 3 ft high, 95 ft long, with a slope of 0.2%. For hydraulic efficiency the culverts chosen have a chamfered inlet as described in Chart 9 of FHWA design guide HDS-5, Hydraulic Design of Highway Culverts. This chart was used in the HEC-2 analysis. Both upstream and downstream, soil-cement aprons with cutoff walls provide transition between the culverts and the unlined diversion channel.

The primary consideration in designing the box culverts was that the culverts not significantly increase water depth or velocity upstream or downstream of construction. The tool for analyzing and verifying the design was the BOSS (tm) version of the Corps of Engineers hydraulic analysis program HEC-2, including the culvert analysis option. Note that all flows are solidly subcritical. The flow rate used was 187 cfs, developed as discussed above.

Included with this report is a LAYOUT & HEC-2 STATIONING schematic. The schematic shows the culverts, the soil-cement aprons, the earth transitions to the existing channel geometry, and several downstream 'dummy' stations. The dummy stations allow HEC-2 to begin at normal depth at the most downstream station and then stabilize before being affected by the reach of channel that is really of interest.

Because the channel might in the future be maintained/reconstructed to its design condition, the analysis consisted of HEC-2 runs showing how the proposed culverts worked with both design and actual existing conditions. Run 'RONJH2A' is for actual existing conditions and run 'RONJH2C' is for the channel as designed by AAR. Verifying the design consists of noting in the HEC-2 output that the depth upstream of the construction area is no higher than in the normal channel downstream, and that the velocity downstream is not significantly increased.

The culverts chosen flow part-full and perform satisfactorily in both cases. Depth and velocity vary slightly with each run; see the included HEC-2 output for details. For the 'actual existing conditions' run (A), depth and velocity per HEC-2 are 2.60 ft and 3.21 fps at downstream natural channel and 2.54 ft and 3.40 fps at the upstream end of the upstream soil-cement apron. Flow properties calculated by HEC-2 may vary slightly from similar properties calculated by other methods. However, in each case, within HEC-2, the upstream depth is not more than the downstream depth.

CONCLUSIONS

The three CBC's shown on the plans will be constructed to contain the 100 year flow without adversely affecting conditions upstream or downstream. Transition to the existing channel is by one-foot thick soil cement aprons extending twenty feet from the upstream and downstream ends of the culverts. Cut-off walls two feet deep will protect the outer ends of the soil cement from being undermined. Future development of upstream properties must manage runoff so as to not exceed channel capacity.

END OF REPORT

September 2, 1997 (2:51pm)

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TABLE 1.

FILE = RONJON.WQ1
 ALBUQUERQUE, NM, DPM (1/93) CRITERIA - SIMPLE PROCEDURE FOR <= 40 ACRES
 PX100-6 = PRECIPITATION EXCESS FROM 100-YEAR 6-HOUR STORM
 VOL10D = VOLUME OF RUNOFF FROM 100-YEAR 10-DAY STORM
 TRMT CLASS A=UNDISTURBED, B=LAWNS, C=UNPAVED ROADS, D=ROOFS, PAVEMENT
 SEE DPM P 22.5-5

***** PROJECT INFO *****

RON JOHNSON PROJECT
 CITY OF ALBUQUERQUE

EXISTING CONDITIONS FROM "DRAINAGE REPORT FOR FOUR HILLS VILLAGE
 18TH INSTALLMENT SITE IMPROVEMENTS (ANDREWS, ASBURY & ROBERT, INC.; NOV,1978)

RAIN ZONE 3 SEE DPM P 22.2-2

-100-YEAR PRECIPITATION (P) DEPTHS, INCHES

	1 HR	6 HR	24 HR	4 DAY	10 DAY
	2.14	2.60	3.10	3.95	4.90

01/08/96 02:21 PM EXISTING CONDITIONS - SUBBASIN D-3							
TRMT	AREA	AREA	PX100-6	QP100-6	QP100-6	VOL6HR	
CLASS	SQUARE FT.	ACRES	IN/AC	CFS/AC	CFS	AC-FT	
A	0.00	0.0000	0.66	1.87	0.000	0.000	
B	217800.90	5.0000	0.92	2.60	13.000	0.383	
C	0.00	0.0000	1.29	3.45	0.000	0.000	
D	0.00	0.0000	2.36	5.02	0.000	0.000	
TOTAL	217800.90	5.0000			13.000	0.383	
					CU FT	16698	

01/08/96 02:21 PM EXISTING CONDITIONS - SUBBASIN D-4							
TRMT	AREA	AREA	PX100-6	QP100-6	QP100-6	VOL6HR	
CLASS	SQUARE FT.	ACRES	IN/AC	CFS/AC	CFS	AC-FT	
A	0.00	0.0000	0.66	1.87	0.000	0.000	
B	239581.00	5.5000	0.92	2.60	14.300	0.422	
C	0.00	0.0000	1.29	3.45	0.000	0.000	
D	0.00	0.0000	2.36	5.02	0.000	0.000	
TOTAL	239581.00	5.5000			14.300	0.422	
					CU FT	18368	

01/08/96 02:21 PM EXISTING CONDITIONS - SUBBASIN D-5							
TRMT	AREA	AREA	PX100-6	QP100-6	QP100-6	VOL6HR	
CLASS	SQUARE FT.	ACRES	IN/AC	CFS/AC	CFS	AC-FT	
A	0.00	0.0000	0.66	1.87	0.000	0.000	
B	82764.30	1.9000	0.92	2.60	4.940	0.146	
C	0.00	0.0000	1.29	3.45	0.000	0.000	
D	0.00	0.0000	2.36	5.02	0.000	0.000	
TOTAL	82764.30	1.9000			4.940	0.146	
					CU FT	6345	

01/08/96 02:21 PM EXISTING CONDITIONS - SUBBASIN D-6							
TRMT	AREA	AREA	PX100-6	QP100-6	QP100-6	VOL6HR	
CLASS	SQUARE FEI	ACRES	IN/AC	CFS/AC	CFS	AC-FT	
A	0.00	0.0000	0.66	1.87	0.000	0.000	
B	117612.50	2.7000	0.92	2.60	7.020	0.207	
C	0.00	0.0000	1.29	3.45	0.000	0.000	
D	0.00	0.0000	2.36	5.02	0.000	0.000	
TOTAL	117612.50	2.7000			7.020	0.207	
					CU FT	9017	

TABLE 1 CONT.

01/08/96 02:21 PM EXISTING CONDITIONS - SUBBASIN D-7							
TRMT	AREA	AREA	PX100-6	QP100-6	QP100-6	VOL6HR	
CLASS	SQUARE FEI	ACRES	IN/AC	CFS/AC	CFS	AC-FT	
A	0.00	0.0000	0.66	1.87	0.000	0.000	
B	191664.80	4.4000	0.92	2.60	11.440	0.337	
C	0.00	0.0000	1.29	3.45	0.000	0.000	
D	0.00	0.0000	2.36	5.02	0.000	0.000	
TOTAL	191664.80	4.4000			11.440	0.337	
					CU FT	14694	

01/08/96 02:21 PM EXISTING CONDITIONS - SUBBASIN D-8							
TRMT	AREA	AREA	PX100-6	QP100-6	QP100-6	VOL6HR	
CLASS	SQUARE FEI	ACRES	IN/AC	CFS/AC	CFS	AC-FT	
A	0.00	0.0000	0.66	1.87	0.000	0.000	
B	2278197.10	52.3002	0.92	2.60	135.981	4.010	
C	0.00	0.0000	1.29	3.45	0.000	0.000	
D	0.00	0.0000	2.36	5.02	0.000	0.000	
TOTAL	2278197.10	52.3002			135.981	4.010	
					CU FT	174662	

01/08/96 02:21 PM EXISTING CONDITIONS - TOTAL RUNOFF (D-3 THRU D-8)							
TRMT	AREA	AREA	PX100-6	QP100-6	QP100-6	VOL6HR	
CLASS	SQUARE FEI	ACRES	IN/AC	CFS/AC	CFS	AC-FT	
A	0.00	0.0000	0.66	1.87	0.000	0.000	
B	3127620.00	71.8003	0.92	2.60	186.681	5.505	
C	0.00	0.0000	1.29	3.45	0.000	0.000	
D	0.00	0.0000	2.36	5.02	0.000	0.000	
TOTAL	3127620.00	71.8003			186.681	5.505	
					CU FT	239784	

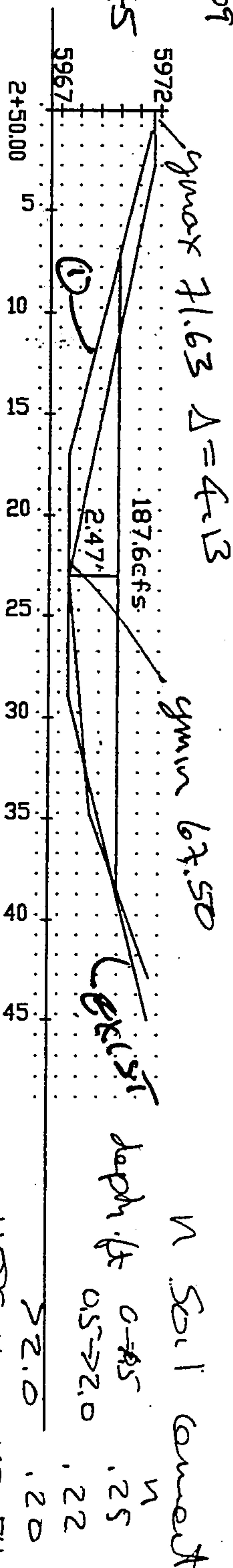
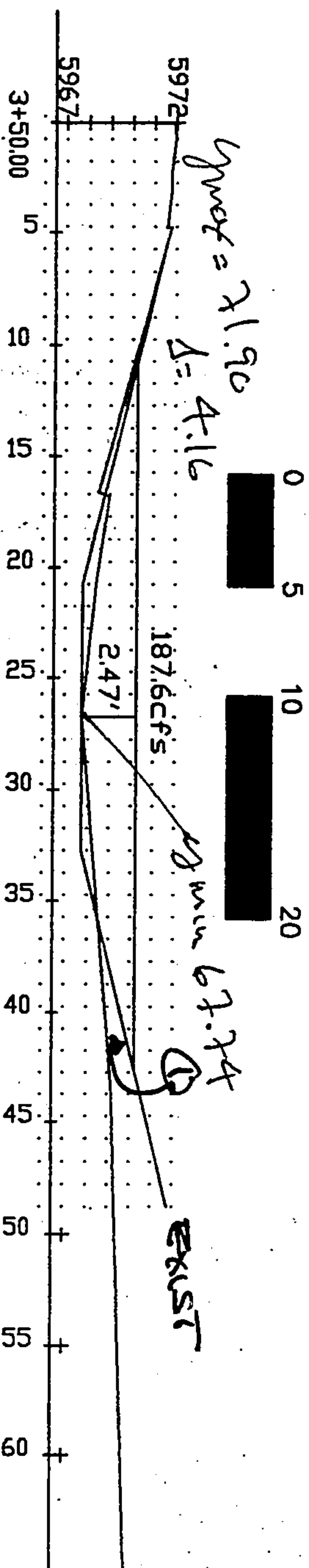
APPENDIX 1

HEC - 2

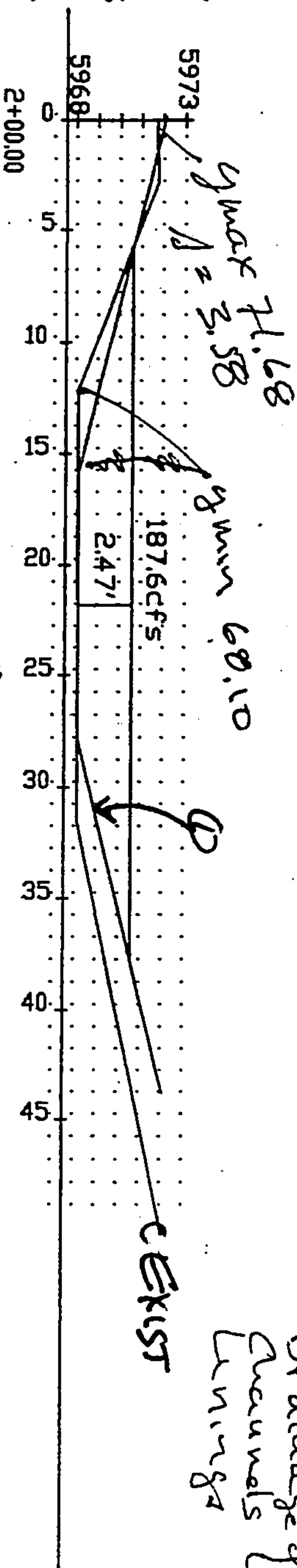
(Inroad 3+52-
 Inroad 1+52)

$$= 67.74 - 67.65 = .09$$

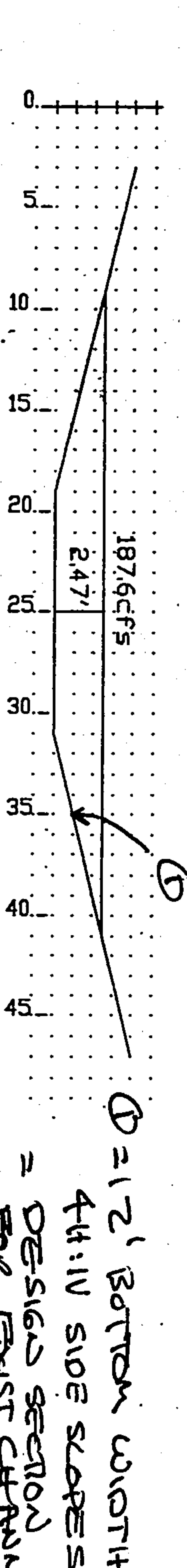
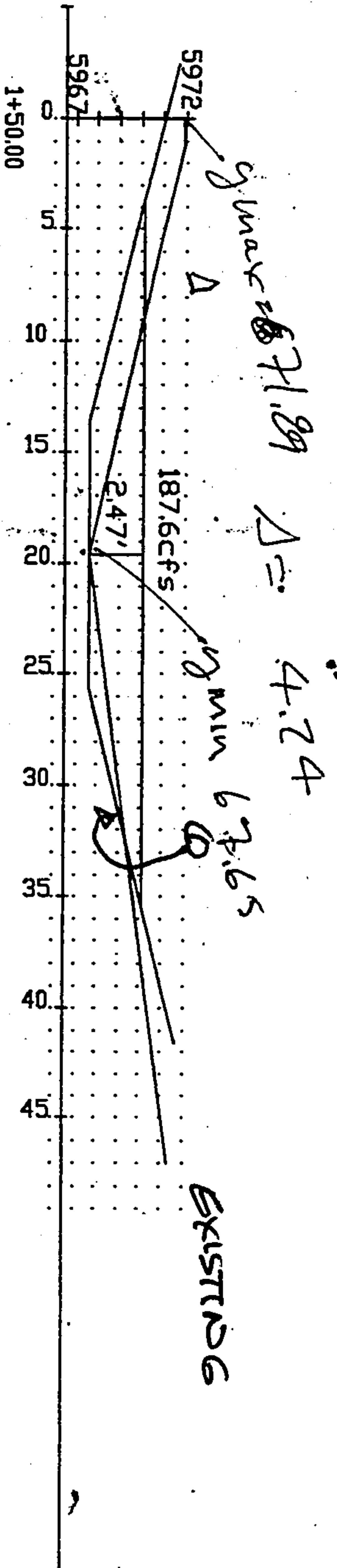
$$S = .09 \div 350 - 150 = .00045$$



1.25 HEC 15 FLOW A
 Drainage of Roadside
 Channels with Flexible
 Linings



NOTE:
 STATIONING THESE
 SECTIONS =
 CENTER BASELINE
 STATIONING
 FOR PUMP STATION 4
 (DETAIL SHEET)



① = 12' BOTTOM WIDTH
 44:11 SIDE SLOPES
 = DESIGN SECTION
 FOR EXIST CHANNEL

PROJECT TITLE : ADD CULVERTS TO BX 4HILLS DIVERSION CHAN

PROJECT NUMBER : FILE=RONJH2A, CULVERTS FOR RON JOHNSON

6/26/1997

=====

BOSS HEC-2 for AutoCAD (tm)

=====

Copyright (C) 1994 BOSS International
All Rights Reserved

Version : 2.0

Serial Number : 20953

Licensed to Per Se Engineering

PROGRAM ORIGIN :

BOSS HEC-2 for AutoCAD is an enhanced version of the U.S. Army Corps of Engineers Hydrologic Engineering Center HEC-2 program for water-surface profile computations. Program based upon the September 1990 version, updated on August 1991.

DISCLAIMER :

BOSS HEC-2 for AutoCAD is a complex program which requires engineering expertise to use correctly. BOSS International assumes absolutely no responsibility for the correct use of this program. All results obtained should be carefully examined by an experienced professional engineer to determine if they are reasonable and accurate.

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In no event shall BOSS International be liable to anyone for special, collateral, incidental, or consequential damages in connection with or arising out of purchase or use of this software. The sole and exclusive liability to BOSS International, regardless of the form of action, shall not exceed the purchase price of this software.

PROJECT DESCRIPTION :

PROJECT TITLE : ADD CULVERTS TO BX 4HILLS DIVERSION CHAN
PROJECT NUMBER : FILE=RONJH2A, CULVERTS FOR RON JOHNSON
DESCRIPTION : BX CHAN: BW=16, SS=3H:1V, S=.002, n=.035
ENGINEER : TUCKER GREEN, P.E.
DATE OF RUN : 6/26/1997
TIME OF RUN : 8:31 am

" " A
n=.035
S=2.0020
Lc 3 1

PROJECT TITLE : ADD CULVERTS TO EX 4HILLS DIVERSION CHAN
PROJECT NUMBER : FILE=RONJH2A, CULVERTS FOR RON JOHNSON

6/26/1997

T1 FILE=RONJH2A, CULVERTS FOR RON JOHNSON
T2 ADD CULVERTS TO EX 4HILLS DIVERSION CHAN
T3 EX CHAN: BW=16, SS=3H:1V, S=.002, n=.035
T4 ADD CULVERTS FOR ROAD CROSSING OVER EXISTING BARTHEN DIVERSION CHANNEL,
T4 ALBUQUERQUE NM. CHANNEL DESIGNED BY ANDREWS, ASBURY AS 12' BOTTOM, 4:1
T4 SIDES, S=0.0025, n=0.030. AS EXISTING LOOKS MORE LIKE 16' BOTTOM & 3:1
T4 S POSS 0.002, n POSS HIGHER, POSS 0.035

JOB PARAMETERS :

J1 ICHECK INQ MINV IDIR STRT METRIC HVINS Q WSEL PQ
2 0.002 187 69.4
J2 NPROF IPLOT PRFVS XSECV XSECH FN ALLDC IBN CHNIM ITRACE
-1 -1 -1 -6

USER-DEFINED SUMMARY TABLES (J3) :

38	43	25	4	8	1	3	33	5	17
14	26	68		38	43	39	66	42	1
2	58	10	12	11		101			

REQUESTED CROSS-SECTION PRINTOUTS (J5) :

-10 -10

FRICTION LOSS EQUATION OPTION (J6) :

J6 IHLBQ ICOPY SUBDIV STRTDS RMLB

1 0

NC
NH 1 0.035 40 0.1 0.3

DUMMY START STATION, AKA B4
100' DWN FROM TIE TO EX BANKS.
STA'S 125 - 175 ALSO DUMMIES
DUMMY START STATION, AKA B4

100' DWN FROM TIE TO EX BANKS.

PROJECT TITLE : ADD CULVERTS TO EX 4HILLS DIVERSION CHAN

PROJECT NUMBER : FILE=RONJH2A, CULVERTS FOR RON JOHNSON

6/26/1997

STA'S 125 - 175 ALSO DUMMIES

X1	1000	7	0	40					
X3	10								
GR	71.02	0	70.02	3	69.02	6	68.02	9	67.02
GR	67.02	28	71.02	40					12

1	0.035	40
DUMMY EXIST, AKA B3		
DUMMY EXIST, AKA B3		

X1	1250	7	0	40		25		
X3	10							
GR	71.07	0	70.07	3	69.07	6	68.07	9
GR	67.07	28	71.07	40				67.07
								12

NE	1	0.035	40
DUMMY EXIST			
DUMMY EXIST			

X1	1500	7	0	40		25	
X3	10						
GR	71.12	0	70.12	3	69.12	6	68.12
GR	67.12	28	71.12	40		9	67.12
							12

NE	1	0.035	40
DUMMY EXIST			
DUMMY EXIST			

X1	1750	7	0	40		25	
X3	10						
GR	71.17	0	70.17	3	69.17	6	68.17
GR	67.17	28	71.17	40		9	67.17
							12

NE	1	0.035	39.94
TIE TO EX BANKS			
TIE TO EX BANKS			

X1	2000	10	0	39.94		25	
X3	10						
GR	71	0	70	3.96	69	7.16	68
GR	67.22	27.89	68	30.62	69	34.49	70
							9.19
							37.77
							67.22
							71
							12.14
							39.94

NE	1	0.035	34.64
224.9: END DIRT @ SOIL CEMENT			
224.9: END DIRT @ SOIL CEMENT			

X1	2249	8	0	34.64		24.9	
X3	10						
GR	71	0	70	2.5	69	5	68
GR	67.27	25.32	68	27.14	71	34.64	7.5
							67.27
							9.32

PROJECT TITLE : ADD CULVERTS TO EX 4HILLS DIVERSION CHAN
PROJECT NUMBER : FILE=RONJH2A, CULVERTS FOR RON JOHNSON

6/26/1997

NH 1 0.02 34

DWN END SOIL CEMENT APRON

DWN END SOIL CEMENT APRON

X1 2250 16 0 34 0.1

X3 10

GR 71.27 0 70.27 0.01 70.27 3 69.27 3.01 69.27 6

GR 68.27 6.01 68.27 9 67.27 9.01 67.27 24.99 68.27 25

GR 68.27 27.99 69.27 28 69.27 30.99 70.27 31 70.27 33.99

GR 71.27 34

NC 0.3 0.5

NH 1 0.02 26

DWNSTR FACE OF CULVERT

DWNSTR FACE OF CULVERT

X1 2450 16 0 26 20

X3 10

GR 71.31 0 70.31 0.01 70.31 1 69.31 75.5 69.31 75.5 2

GR 68.31 2.01 68.31 3 67.31 3.01 67.31 22.99 68.31 23

GR 68.31 23.99 69.31 24 69.31 24.99 70.31 25 70.31 25.99

GR 71.31 26

NC 0.1 0.3

NH 1 0.02 26

SC 3.013 0.2 2.7 26 3 6 95 9.2 67.5 67.31

UPSTR FACE OF CULVERT

UPSTR FACE OF CULVERT

X1 3400 16 0 26 95

X2 2

74.5

X3 10

GR 71.5 0 70.5 0.01 70.5 1 69.5 75.5 75.5 2

GR 68.5 2.01 68.5 3 67.5 3.01 67.5 22.99 68.5 23

GR 68.5 23.99 69.5 24 69.5 24.99 70.5 25 70.5 25.99

GR 71.5 26

NH 1 0.02 37

UPSTR END SOIL CEMENT APRON

UPSTR END SOIL CEMENT APRON

X1 3600 16 0 37 20

X3 10

GR 71.54 0 70.54 0.01 70.54 3 69.54 3.01 69.54 6

GR 68.54 6.01 68.54 9 67.54 9.01 67.54 24.99 68.54 25

GR 68.54 28.99 69.54 29 69.54 32.99 70.54 33 70.54 36.99

GR 71.54 37

NH 1 0.035 36.25

DIRT, 0.1' UP FROM SOIL CEMENT

DIRT, 0.1' UP FROM SOIL CEMENT

PROJECT TITLE : ADD CULVERTS TO EX 4HILLS DIVERSION CHAN
PROJECT NUMBER : FILE=RONJH2A, CULVERTS FOR RON JOHNSON

6/26/1997

X1	3601	6	0	36.25	0.1				
X3	10								
GR	71	0	68	7.5	67.54	8.65	67.54	24.65	68
GR	71	36.25						26.15	

STATUS: Friction loss equation index (IHLEQ) = 1. Therefore friction loss (HL) is calculated as a function of the profile type, which can vary from reach to reach. See documentation for further details.

SPECIAL NOTE :

An asterisk (*) to the left of the cross-section number indicates a special note is present in the SUMMARY OF WARNING AND STATUS MESSAGES section.

SUMMARY PRINTOUT : ADD CULVERTS TO EX 4HILLS DIVERSION CHAN

EX CHAN: BM=16, SS=3H.1V, S=.002, n=.035

FILE=RONJH2A, CULVERTS FOR RON JOHNSON

Cross- Section Number	Discharge Flow	Cross- Section Area	Water Surface Top Width	Flow Depth	Computed W. S. Elevation	Energy Gradient Elevation	Channel Slope	Energy Gradient Slope	Channel Manning n	Channel Flow	Channel Mean Flow Velocity	Channel Froude Number
SECNO	Q	ARBA	TOPWID	DEPTH	CMSBL	EG	K*CHSL	10K*S	K*XMCH	QCH	VCH	FRCH
1000.000	187.00	63.41	31.89	2.65	69.67	69.80	0.00	19.99	35.00	187.00	2.95	0.37
1250.000	187.00	63.41	31.89	2.65	69.72	69.85	2.00	19.99	35.00	187.00	2.95	0.37
1500.000	187.00	63.41	31.89	2.65	69.77	69.90	2.00	19.99	35.00	187.00	2.95	0.37
1750.000	187.00	63.41	31.89	2.65	69.82	69.95	2.00	19.99	35.00	187.00	2.95	0.37
2000.000	187.00	65.28	33.00	2.66	69.88	70.00	2.00	18.95	35.00	187.00	2.86	0.36
2249.000	187.00	59.33	29.14	2.64	69.91	70.06	2.01	22.35	35.00	187.00	3.15	0.39
* 2250.000	187.00	55.63	27.99	2.62	69.89	70.07	0.00	10.28	20.00	187.00	3.36	0.42
2450.000	187.00	56.37	23.99	2.61	69.92	70.09	2.00	8.27	20.00	187.00	3.32	0.38
3400.000	187.00	57.18	23.99	2.63	70.13	70.30	2.00	7.91	20.00	187.00	3.27	0.37
3600.000	187.00	57.09	29.99	2.61	70.15	70.32	2.00	10.18	20.00	187.00	3.28	0.42

PROJECT TITLE : ADD CULVERTS TO EX 4HILLS DIVERSION CHAN

PROJECT NUMBER : FILE=RONJH2A, CULVERTS FOR RON JOHNSON

6/26/1997

Cross- Section Number	Discharge Flow	Cross- Section Area	Water Surface Top Width	Flow Depth	Computed W. S. Elevation	Energy Gradient Elevation	Channel Slope	Energy Gradient Slope	Channel Manning n	Channel Flow	Channel Mean Flow Velocity	Channel Froude Number
	(cfs)	(sq ft)	(ft)	(ft)	(ft MSL)	(ft MSL)	* 1,000	* 10,000	* 1,000	(cfs)	(ft/s)	
SECNO	Q	AREA	TOPWID	DEPTH	CWSEL	BG	K*CHSL	10K*S	K*XMCH	QCH	VCH	FRCH
3601.000	187.00	62.61	31.45	2.64	70.18	70.32	0.00	20.51	35.00	187.00	2.99	0.37

SUMMARY PRINTOUT : ADD CULVERTS TO EX 4HILLS DIVERSION CHAN

EX CHAN: BW=16, SS=3H:1V, S=.002, n=.035

FILE=RONJH2A, CULVERTS FOR RON JOHNSON

Cross- Section Number	Discharge Flow	Channel Reach Length	Cumulative Channel Distance	Minimum C. S. Elevation	Computed W. S. Elevation	Critical W. S. Elevation	Up/Down Conveyance Ratio	Mean Velocity Head	Other Energy Loss	Friction Energy Loss
SECNO	Q	XLCH	CUMDS	ELMIN	CWSEL	CRIMS	KRATIO	HV	OLOSS	HL
1000.000	187.00	0.00	0.00	67.02	69.67	68.48	0.00	0.14	0.00	0.00
1250.000	187.00	25.00	25.00	67.07	69.72	68.54	1.00	0.14	0.00	0.05
1500.000	187.00	25.00	50.00	67.12	69.77	68.59	1.00	0.14	0.00	0.05
1750.000	187.00	25.00	75.00	67.17	69.82	68.64	1.00	0.14	0.00	0.05
2000.000	187.00	25.00	100.00	67.22	69.88	68.67	1.03	0.13	0.00	0.05
2249.000	187.00	24.90	124.90	67.27	69.91	68.76	0.92	0.15	0.01	0.05
* 2250.000	187.00	0.10	125.00	67.27	69.89	68.85	1.47	0.18	0.01	0.00
2450.000	187.00	20.00	145.00	67.31	69.92	68.71	1.12	0.17	0.00	0.02
3400.000	187.00	95.00	240.00	67.50	70.13	0.00	1.02	0.17	0.00	0.21
3600.000	187.00	20.00	260.00	67.54	70.15	69.11	0.88	0.17	0.00	0.02
3601.000	187.00	0.10	260.10	67.54	70.18	69.01	0.70	0.14	0.00	0.00

PROJECT TITLE : ADD CULVERTS TO EX 4HILLS DIVERSION CHAN

PROJECT NUMBER : FILE=RONJH2A, CULVERTS FOR RON JOHNSON

6/26/1997

SUMMARY PRINTOUT TABLE 101 : ADD CULVERTS TO EX 4HILLS DIVERSION CHAN

----- EX CHAN: BW=16, SS=3H:1V, S=.002, n=.035
FILE=RONJH2A, CULVERTS FOR RON JOHNSON

Cross- Section Number	Outlet Control EGL Elev. (ft MSL)	Max. Chord Elevation (ft MSL)	Low Inlet Control EGL Elev. (ft MSL)	Top of Roadway Elevation (ft MSL)	Flow Through Culvert (cfs)	Total Bridge Weir Flow (cfs)	Bridge Flow Class	W. S. Surface Difference (ft)	Flow Depth (ft)	Computed W. S. Elevation (ft MSL)	Channel Mean Flow Velocity (ft/s)	Energy Gradient Elevation (ft MSL)
SECCNO	EGOC	ELLC	EGIC	ELTRD	QCULV	QWEIR	CLASS	H4	DEPTH	CWSEL	VCH	BG
3400.000	70.30	0.00	69.81	74.50	187.00	0.00	7.00	0.21	2.63	70.13	3.27	70.30

SUMMARY OF WARNING AND STATUS MESSAGES :

Section 2250, profile 1, conveyance change outside acceptable range.

1 Warning and status message(s) generated

END OF OUTPUT

PROJECT TITLE : ADD CULVERTS TO BX 4HILLS DIVERSION CHAN

PROJECT NUMBER : FILB=RONJH2C, CULVERTS FOR RON JOHNSON

6/26/1997

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BOSS HEC-2 for AutocAD (tm)

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Version : 2.0

Serial Number : 20953

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PROGRAM ORIGIN :

BOSS HEC-2 for AutocAD is an enhanced version of the U.S. Army Corps of Engineers Hydrologic Engineering Center HEC-2 program for water-surface profile computations. Program based upon the September 1990 version, updated on August 1991.

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PROJECT DESCRIPTION :

PROJECT TITLE : ADD CULVERTS TO BX 4HILLS DIVERSION CHAN
PROJECT NUMBER : FILB=RONJH2C, CULVERTS FOR RON JOHNSON
DESCRIPTION : BX CHAN: BW=12, SS=4H:1V, S=.0025, n=.03
ENGINEER : TUCKER GREEN, P.E.
DATE OF RUN : 6/26/1997
TIME OF RUN : 9:09 am



N = .030
S = ~~.0025~~ .0025 %



PROJECT TITLE : ADD CULVERTS TO EX 4HILLS DIVERSION CHAN

PROJECT NUMBER : FILE=RONJH2C, CULVERTS FOR RON JOHNSON

6/26/1997

T1 FILE=RONJH2C, CULVERTS FOR RON JOHNSON
T2 ADD CULVERTS TO EX 4HILLS DIVERSION CHAN
T3 EX CHAN: BM=12, SS=4H:1V, S=.0025, n=.030
T4 ADD CULVERTS FOR ROAD CROSSING OVER EXISTING EARTHEN DIVERSION CHANNEL,
T4 ALBUQUERQUE NM. CHANNEL DESIGNED BY ANDREWS, ASBURY AS 12' BOTTOM, 4:1
T4 SIDES, S=0.0025, n=0.030. AS EXISTING LOOKS MORE LIKE 16' BOTTOM & 3:1
T4 S POSS 0.002, n POSS HIGHER, POSS 0.035

JOB PARAMETERS :

J1 ICHECK INQ MINV IDIR STRT METRIC HVINS Q WSEL FQ
2 0.002 187 69.4
J2 NPROF IPLOT PRFVS XSECV XSECH FN ALLDC IBW CHNIM ITRACE
-1 -1 -1 -6

USER-DEFINED SUMMARY TABLES (J3) :

38	43	25	4	8	1	3	33	5	17
14	26	68		38	43	39	66	42	1
2	58	10	12	11		101			

REQUESTED CROSS-SECTION PRINTOUTS (J5) :

-10 -10

FRICTION LOSS EQUATION OPTION (J6) :

J6 IHLBO ICOPY SUBDIV STRTDS RMILB

1 0

NC 1 0.03 44 0.1 0.3

NH 1 0.03 44

DUMMY START STATION, AKA B4

100' DWN FROM TIE TO EX BANKS.

STA'S 125 - 175 ALSO DUMMIRS

DUMMY START STATION, AKA B4

100' DWN FROM TIE TO EX BANKS.

PROJECT TITLE : ADD CULVERTS TO EX 4HILLS DIVERSION CHAN
PROJECT NUMBER : FILE=RONJH2C, CULVERTS FOR RON JOHNSON

6/26/1997

STA'S 125 - 175 ALSO DUMMIES

X1	1000	4	0	44					
X3	10								
GR	70.97	0	66.97	16	66.97	28	70.97	44	

NH 1 0.03 44
DUMMY EXIST, AKA B3
DUMMY EXIST, AKA B3

X1	1250	4	0	44					25
X3	10								
GR	71.03	0	67.03	16	67.03	28	71.03	44	

NH 1 0.03 44
DUMMY EXIST
DUMMY EXIST

X1	1500	4	0	44					25
X3	10								
GR	71.1	0	67.1	16	67.1	28	71.1	44	

NH 1 0.03 44
DUMMY EXIST
DUMMY EXIST

X1	1750	4	0	44					25
X3	10								
GR	71.16	0	67.16	12	67.16	28	71.16	44	

NH 1 0.03 39.94
TIB TO EX BANKS
TIB TO EX BANKS

X1	2000	10	0	39.94					25
X3	10								
GR	71	0	70	3.96	69	7.16	68	9.19	67.22
GR	67.22	27.89	68	30.62	69	34.49	70	37.77	71

NH 1 0.03 34.64
224.9: BND DIRT @ SOIL CEMENT
224.9: BND DIRT @ SOIL CEMENT

X1	2249	8	0	34.64					24.9
X3	10								
GR	71	0	70	2.5	69	5	68	7.5	67.27
GR	67.27	25.32	68	27.14	71	34.64			9.32

NH 1 0.02 34
DWN BND SOIL CEMENT APRON
DWN BND SOIL CEMENT APRON

PROJECT TITLE : ADD CULVERTS TO EX 4HILLS DIVERSION CHAN

PROJECT NUMBER : FILE=RONJH2C, CULVERTS FOR RON JOHNSON

6/26/1997

X1	2250	16	0	34	0.1				
X3	10								
GR	71.27	0	70.27	0.01		3	69.27	3.01	69.27
GR	68.27	6.01	68.27	9		9.01	67.27	24.99	68.27
GR	68.27	27.99	69.27	28		30.99	70.27	31	70.27
GR	71.27	34							33.99

NC			0.3	0.5					
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NH	1	0.02	26						
----	---	------	----	--	--	--	--	--	--

DNMSTR FACE OF CULVERT

DNMSTR FACE OF CULVERT

X1	2450	16	0	26	20				
X3	10					75.5	75.5		
GR	71.31	0	70.31	0.01		1	69.31	1.01	69.31
GR	68.31	2.01	68.31	3		3.01	67.31	22.99	68.31
GR	68.31	23.99	69.31	24		24.99	70.31	25	70.31
GR	71.31	26							25.99

NC			0.1	0.3					
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NH	1	0.02	26						
----	---	------	----	--	--	--	--	--	--

SC 3.013 0.2 2.7 26 3 6 95 9.2 67.5 67.31

UPSTR FACE OF CULVERT

UPSTR FACE OF CULVERT

X1	3400	16	0	26	95				
X2			2			74.5			
X3	10					75.5	75.5		
GR	71.5	0	70.5	0.01		1	69.5	1.01	69.5
GR	68.5	2.01	68.5	3		3.01	67.5	22.99	68.5
GR	68.5	23.99	69.5	24		24.99	70.5	25	70.5
GR	71.5	26							25.99

NH	1	0.02	37						
----	---	------	----	--	--	--	--	--	--

UPSTR END SOIL CEMENT APRON

UPSTR END SOIL CEMENT APRON

X1	3600	16	0	37	20				
X3	10								
GR	71.54	0	70.54	0.01		3	69.54	3.01	69.54
GR	68.54	6.01	68.54	9		9.01	67.54	24.99	68.54
GR	68.54	28.99	69.54	29		32.99	70.54	33	70.54
GR	71.54	37							36.99

NH	1	0.03	36.25						
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DIRT, 0.1' UP FROM SOIL CEMENT

DIRT, 0.1' UP FROM SOIL CEMENT

X1	3601	6	0	36.25	0.1				
X3	10								
GR	71	0	68	7.5		8.65	67.54	24.65	68
GR	71	36.25							26.15

PROJECT TITLE : ADD CULVERTS TO EX 4HILLS DIVERSION CHAN

PROJECT NUMBR : FILE=RONJH2C, CULVERTS FOR RON JOHNSON

6/26/1997

STATUS: Friction loss equation index (IHLRQ) = 1. Therefore friction loss (HL) is calculated as a function of the profile type, which can vary from reach to reach. See documentation for further details.

SPECIAL NOTE :

An asterisk (*) to the left of the cross-section number indicates a special note is present in the SUMMARY OF WARNING AND STATUS MESSAGES section.

SUMMARY PRINTOUT : ADD CULVERTS TO EX 4HILLS DIVERSION CHAN

EX CHAN: BM=12, SS=4H:1V, S=.0025, n=.03

FILE=RONJH2C, CULVERTS FOR RON JOHNSON

Cross- Section Number	Discharge Flow	Cross- Section Area	Water Surface Top Width	Flow Depth	Computed W. S. Elevation	Energy Gradient Elevation	Channel Slope	Energy Gradient Slope	Channel Manning n	Channel Flow	Channel Mean Flow Velocity	Channel Froude Number
SECNO	Q	ARBA	TOPWID	DEPTH	CMSL	EG	K*CHSL	10K*S	K*XNCH	QCH	VCH	FRCH
1000.000	187.00	58.30	32.82	2.60	69.57	69.73	0.00	19.99	30.00	187.00	3.21	0.42
1250.000	187.00	57.95	32.73	2.59	69.62	69.78	2.40	20.33	30.00	187.00	3.23	0.43
1500.000	187.00	57.26	32.56	2.57	69.67	69.84	2.80	21.01	30.00	187.00	3.27	0.43
1750.000	187.00	65.07	34.16	2.59	69.75	69.88	2.40	14.67	30.00	187.00	2.87	0.37
2000.000	187.00	62.04	32.36	2.56	69.78	69.92	2.40	16.06	30.00	187.00	3.01	0.38
2249.000	187.00	56.36	28.62	2.54	69.81	69.98	2.01	19.01	30.00	187.00	3.32	0.42
2250.000	187.00	52.77	27.99	2.52	69.79	69.98	0.00	12.16	20.00	187.00	3.54	0.45
2450.000	187.00	54.34	23.99	2.52	69.83	70.01	2.00	9.27	20.00	187.00	3.44	0.40
3400.000	187.00	55.46	23.99	2.56	70.06	70.24	2.00	8.70	20.00	187.00	3.37	0.39
3600.000	187.00	54.94	29.99	2.54	70.08	70.26	2.00	11.51	20.00	187.00	3.40	0.44
3601.000	187.00	60.48	31.05	2.57	70.11	70.26	0.00	16.61	30.00	187.00	3.09	0.39

PROJECT TITLE : ADD CULVERTS TO EX 4HILLS DIVERSION CHAN

PROJECT NUMBER : FILE=RONJH2C, CULVERTS FOR RON JOHNSON

6/26/1997

SUMMARY PRINTOUT : ADD CULVERTS TO EX 4HILLS DIVERSION CHAN

----- EX CHAN: BW=12, SS=4H:1V, S=.0025, n=.03

FILE=RONJH2C, CULVERTS FOR RON JOHNSON

Cross- Section Number	Discharge Flow (cfs)	Channel Reach Length (ft)	Cumulative Channel Distance (ft)	Minimum C. S. Elevation (ft MSL)	Computed W. S. Elevation (ft MSL)	Critical W. S. Elevation (ft MSL)	Up/Down Conveyance Ratio	Mean Velocity Head (ft)	Other Energy Loss (ft)	Friction Energy Loss (ft)
SECNO	Q	XLCH	CUMDS	ELMIN	CMSEL	CRIMS	KRATIO	HV	OLOSS	HL
1000.000	187.00	0.00	0.00	66.97	69.57	68.59	0.00	0.16	0.00	0.00
1250.000	187.00	25.00	25.00	67.03	69.62	68.65	0.99	0.16	0.00	0.05
1500.000	187.00	25.00	50.00	67.10	69.67	68.72	0.98	0.17	0.00	0.05
1750.000	187.00	25.00	75.00	67.16	69.75	68.61	1.20	0.13	0.00	0.04
2000.000	187.00	25.00	100.00	67.22	69.78	68.67	0.96	0.14	0.00	0.04
2249.000	187.00	24.90	124.90	67.27	69.81	68.76	0.92	0.17	0.01	0.04
2250.000	187.00	0.10	125.00	67.27	69.79	68.85	1.25	0.19	0.01	0.00
2450.000	187.00	20.00	145.00	67.31	69.83	68.71	1.14	0.18	0.00	0.02
3400.000	187.00	95.00	240.00	67.50	70.06	0.00	1.03	0.18	0.00	0.23
3600.000	187.00	20.00	260.00	67.54	70.08	69.11	0.87	0.18	0.00	0.02
3601.000	187.00	0.10	260.10	67.54	70.11	69.01	0.83	0.15	0.00	0.00

PROJECT TITLE : ADD CULVERTS TO EX 4HILLS DIVERSION CHAN

PROJECT NUMBER : FILE=RONJH2C, CULVERTS FOR RON JOHNSON

6/26/1997

SUMMARY PRINTOUT TABLE 101 : ADD CULVERTS TO EX 4HILLS DIVERSION CHAN

----- EX CHAN: BW=12, SS=4H:1V, S=.0025, n=.03

FILE=RONJH2C, CULVERTS FOR RON JOHNSON

Cross- Section Number	Outlet Control (ft MSL)	Max. low Chord (ft MSL)	Inlet Control (ft MSL)	Top of Roadway Elevation (ft MSL)	Flow Through Culvert (cfs)	Total Bridge Weir Flow (cfs)	Bridge Flow Class	W. S. Surface Difference (ft)	Flow Depth (ft)	Computed W. S. Elevation (ft MSL)	Channel Mean Flow Velocity (ft/s)	Energy Gradient Elevation (ft MSL)
SECNO	EGOC	BLIC	EGIC	ELTRD	QCULV	QWEIR	CLASS	H4	DEPTH	CMSSEL	VCH	EG
3400.000	70.24	0.00	69.81	74.50	187.00	0.00	7.00	0.23	2.56	70.06	3.37	70.24

SUMMARY OF WARNING AND STATUS MESSAGES :

No warning messages generated

END OF OUTPUT

APPENDIX 2

Drainage Report
Four Hills Village Installment 19
Prepared by Andrews Asbury and Robert, Inc.
Date of Report: November 1978

INCLUDED FOR REFERENCE ONLY

PAUL'S HOMES, INC.
ALBUQUERQUE, NEW MEXICO

DRAINAGE REPORT
FOR
FOUR HILLS VILLAGE
NINETEENTH INSTALLMENT
SITE IMPROVEMENTS

NOVEMBER 1978

ANDREWS, ASBURY & ROBERT, INC.
Consulting Engineers
401 San Pedro, N. E.
Albuquerque, New Mexico 87108
505-265-6631

DRAINAGE REPORT
FOR
FOUR HILLS VILLAGE
NINETEENTH INSTALLMENT
SITE IMPROVEMENTS

TABLE OF CONTENTS

	<u>PAGE</u>
I Introduction	1
II Existing Conditions	2
A. Off site Drainage	2
B. On site Drainage	4
III Developed Conditions	5
A. Four Hills Diversion Ditch	5
B. Four Hills Arroyo	6
C. On site Drainage control	7
IV Lot Ponding Requirements	8
<u>MAPS</u>	
Location Map	Map No. 1
Off site Drainage	Map No. 2
V Design Analysis	11
	Sheets 1 through 30
<u>MAPS</u>	
Existing Conditions	Map No. 3
Developed Conditions	Map No. 4
(See special pocket at back of report for Map No. 3 and Map No. 4)	

I

INTRODUCTION

Paul's Homes, Inc. proposes to improve and develop a 53.7 acre tract of land designated as Four Hills Village, Nineteenth Installment, a subdivision located in the far southeast quadrant of the City of Albuquerque. This subdivision is bounded on the south by lands of Kirtland Air Force Base, on the west by Four Hills Village, Installment Seventeen, and on the north and east by Four Hills Village, Installments Eleven, Twelve and Thirteen. (See enclosed Location Map, Map No. 1, page M-23 of the Zone Atlas.)

The storm drainage analysis included in this drainage report was made to determine the storm water runoff anticipated in the event of a 100-year frequency storm and to provide a plan to control storm water runoff under the proposed developed conditions that will conform to applicable drainage resolutions and ordinances.

In order to provide a comprehensive drainage analysis for the Nineteenth Installment it was necessary to study the surrounding and adjacent platted subdivisions including portions of the 11th, 12th, 13th, 17th and 5th Installments of Four Hills Village. The results of this study are included in this report.

II

EXISTING CONDITIONS

The Four Hills Village, Nineteenth Installment subdivision, consists of ground surfaces relatively broken and steep having grades varying from 4% to 7% and presently undeveloped. However, the area lying directly to the west, north, and along the major portion of the east side is in a developed condition. All adjacent development is in residential use.

The south side of the subdivision is bounded by lands of Kirtland Air Force Base. These lands are completely undeveloped and exist in a natural and native condition.

One of the main drainage features of this subdivision consists of a major arroyo, hereinafter referred to as the Four Hills Arroyo, that bisects the subdivision in a southeasterly-northwesterly direction.

A. OFFSITE DRAINAGE

Offsite areas generating storm water runoff to the subdivision are located northeast, east and southeast of the subdivision site and are shown on Map No. 2 and Map No. 3 enclosed herein.

A runoff factor (c) of 0.50 was chosen for use in

determining the runoff rate from offsite drainage areas. This runoff factor determination was based on site field investigations of the areas. The developed areas have a reasonable amount of built-in rear or side yard ponding and sometimes the front yard, to compensate in the majority of the area for the increased rate of runoff created by the hard surface areas. The developed areas combined with the undeveloped areas that have a fairly open graded soil and good vegetative cover allow the factor as chosen to be considered conservative.

1. FOUR HILLS ARROYO - OFFSITE AREA

The offsite drainage area of the Four Hills Arroyo consists of 603.3 acres and is shown on Map No. 2. Limits of the drainage area were determined from Kirtland Base engineer topographic maps. These maps are at a scale of 1" = 200' with contour intervals of 2 feet and were made available by the Albuquerque Metropolitan Arroyo Flood Control Authority. Prints of such maps are on file at the AMAFCA office.

2. OTHER OFFSITE AREAS

The drainage area limits of the offsite areas other than the Four Hills Arroyo were determined from a combination of methods. Orthophoto topographic mapping at a scale of 1" = 200' was utilized where such mapping was available. The remainder of the area limits was determined from USGS topographic maps at a scale of 1" = 2000' along with field site investigations.

As a result of the study made of the offsite drainage areas it was determined that some existing streets in the Four Hills area are unable to carry the flows generated by a 100-year frequency storm and that some residences in the area are subject to flooding conditions by storms of a much lesser magnitude.

B. ON SITE DRAINAGE

On site drainage under existing conditions is shown on Map No. 2 enclosed herein. The on site drainage north and east of the Four Hills Arroyo is carried to the arroyo by natural drainage channels.

The southwest portion of the subdivision site drains into the 17th Installment street system. The present street system carries the flows west and north to a lined drainage easement channel that empties into the Four Hills Arroyo. (See Map No. 2).

The drainage analysis and computations are included hereinafter in this report.

III

DEVELOPED CONDITIONS

The proposed method of both on site and off site drainage for the subdivision under developed conditions is shown on Map No. 4 enclosed herein.

A. FOUR HILLS DIVERSION DITCH

As shown on Map No. 4 it is proposed to build a diversion ditch approximately 2800 feet in length, herein- after referred to as Four Hills Diversion Ditch, along a north-south alignment and located east of the Four Hills Village area. This diversion ditch will intercept all major runoff flows from the off site drainage areas to the east and direct them southerly to the Four Hills Arroyo.

Permission to construct approximately 300 feet of the diversion ditch on the lands of Kirtland Air Force Base has been formally requested by the City of Albuquerque from the Base Engineer approximately 60 days ago. At the time of this writing an answer has not been received as to whether permission will be granted to extend the outlet of the diversion ditch onto Kirtland Base lands. Indications are that permission will be granted.

An alternate to construction of the outlet of the

diversion ditch on the lands of Kirtland Air Force Base would be the construction of a concrete lined channel along the southerly boundary of the subdivision. Limits of this concrete lined channel would be from the point of intersection of the diversion ditch with the north boundary of Kirtland Base, west-ly to the Four Hills Arroyo. (See Map No. 4.)

B. FOUR HILLS ARROYO

As shown on Map No. 4 it is proposed to provide channelization and improvements to the Four Hills Arroyo through the 19th Installment and to the west along the north boundary of the 17th Installment.

Improvements of the arroyo in the 19th Installment include bank protection to confine the flows within the dedicated drainage right-of-way. This bank protection will be provided along the banks of the arroyo between the existing rock outcroppings and will consist of dikes with wire tied rip rap for erosion protection. Other than this bank protection, the arroyo shall be left in its natural state including preservation of the existing vegetation during construction.

Improvements of the arroyo along the north boundary of the 17th Installment consist of constructing a concrete lined channel. Concrete lining of the arroyo along this reach is necessary due to the encroachment of fill into the arroyo

during grading operations performed when developing the 17th
Instalment. Limits of the proposed lining are shown on Map
No. 4.

A drainage structure (dry weather crossing) consist-
ing of five (5) 60-inch diameter culvert pipe is proposed to
be constructed for the Wagontrain Drive crossing of the arroyo.
Erosion protection upstream and downstream of the structure
should be provided.

C. ON SITE DRAINAGE CONTROL

Guidelines to be used in controlling storm water runoff
when developing the subdivision shall be as follows:

1. Provide for backyard and/or roof ponding as necessary
so as not to increase the volume and rate of runoff due to
development of the subdivision. Consideration shall be given to
the fact that due to the steep terrain on which this subdivision
is located, ponding cannot be accomplished on some lots. How-
ever, in considering the total area of the subdivision there
shall be sufficient total ponding provided so as not to increase
runoff due to development of the subdivision.

2. Runoff and ponding determinations shall be made based
on the following surfaces or equivalent.

Front yard and street area	
Hard surfaced area	50%
Landscaped area	50%
Back yard area	
Hard surfaced area	18%
Landscaped area	82%

IV

LOT PONDING REQUIREMENTS

Units to be constructed on lots in this subdivision will consist of residential units varying in size from 2000 ft² to 3000 ft².

The basis and factors for determining lot ponding requirements are shown on sheet 15 of the design analysis. From this sheet 15, the volume per square foot of lot area to be ponded is 0.108 ft³.

Following is a tabulation of the lot ponding requirements:

FOUR HILLS VILLAGE 19th INSTALLMENT

LOT PONDING REQUIREMENTS

Block	Lot No.	Storage Volume (CF)
17-A	42	1268
	43	1429
	44	916
	45	1026
	45	1134
	47	1242
	48	1441
	49	2453
	50	838
	51	1613
17-A		
45-A	21	1199
	22	850
	23	1354
	24	1029
	25	1476
	26	-0-
	27	-0-

LOT PONDING REQUIREMENTS
(Continued)

Block	Lot No.	Storage Volume (CF)
45-A	28	1134
	29	893
	30	1121
	31	1287
	32	1188
	33	1188
	34	1188
45-A	35	1188
	36	1188
	37	1188
48-A	11	-0-
	12	1381
	13	1460
	14	699
	15	-0-
	16	-0-
	17	1307
48-A	18	1083
	19	1294
	20	-0-
	21	-0-
49-A	3	865
	4	1257
	5	1916
	6	1329
	7	950
	8	950
	9	950
	10	950
	11	975
	12	1107
	13	1892
	14	1772
	15	1188
	16	1188
	17	1188
	18	626
	19	551
49-A	20	-0-
	21	-0-
	22	-0-
	23	-0-
49-A	24	2226

LOT PONDING REQUIREMENTS
(Continued)

Block	Lot No.	Storage Volume (CF)
50-A	2	549
	3	662
	4	954
	5	1001
	6	739
	7	972
	8	972
	9	972
	10	811
	11	1865
50-A	12	1339
	22	731
51-A	23	2129
	24	-0-
	25	-0-
	26	-0-
51-A	27	1755
54-A	22	1026
	23	1080
	24	1080
	25	864
	26	1688
	27	886
	28	799
	29	799
	30	799
	31	799
54-A	32	-0-
	33	3313
	34	1522
	35	1242
	36	2339
	37	-0-
	38	-0-
	39	1970
	40	1487
	41	1459
54-A	42	794
	43	616
	44	-0-
	45	864
	46	864
	47	-0-
	48	-0-
	49	-0-

V

DESIGN ANALYSIS

Included hereinafter are the drainage analyses (computations) for the subject subdivision. (See sheets 1 through 30).

FOUR HILLS VILLAGE
NINETEENTH INSTALLMENT
SITE IMPROVEMENTS

DRAINAGE ANALYSIS

Sheet

Criteria, Reference Material
and Design Parameters
1

EXISTING CONDITIONS

Drainage Area	A	2
	B	3
	C	3
	D	4
	E	4
Four Hills Arroyo		5

DEVELOPED CONDITIONS

Four Hills Diversion Ditch	8
Individual Areas	8 - 10
Combined Areas	11 - 13
Lot Runoff Factors & Ponding Factors	14 - 15

Drainage Area C	16
Street Flows	

Drainage Area D	17 - 18
Street & Easement Flows	

Drainage Area E	19
Street & Easement Flows	
Four Hills Arroyo	20 - 22

FACILITY DESIGN

Four Hills Diversion Ditch	23 - 24
Four Hills Arroyo	25 - 27
Camino Cerrito	28
Drainage Easement Channel, Lots 43 & 44, Blk 17	29
Conestoga Drive Cul de Sac	30

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Project FOUR HILLS VILLAGE Sheet 1 of 30
19TH INSTALLMENT Job No. 130
By JA Chkd — Date 11-23-75

DRAINAGE ANALYSIS

CRITERIA-

DESIGN STORM - 100 Year Frequency

REFERENCE MATERIAL

1. Albuquerque Area (1961) Intensity Duration - Frequency Curves
2. 100 Year - 6 Hour Precipitation Rainfall Frequency Map for New Mexico - U.S. Weather Bureau. 1967
3. Time of Concentration Nomograph by P.Z. Kirpich.

DESIGN PARAMETERS

Peak Runoff Rate - Rational Formula
 $Q = CIA$

Runoff Volume. $V = \text{Runoff Coefficient} \times \text{Rainfall} \times \text{Area}$

Runoff Coefficients

Offsite & Existing Conditions = 0.50
Hard Surface = 0.90
Landscaped Surface = 0.40

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Project FOUR HILLS VILLAGE Sheet 2 of 30
19 TH INSTALLMENT Job No. 130
By JA Chkd _____ Date 11-28-73

EXISTING CONDITIONS

For offsite drainage Areas - See Map No. 2
and for on site drainage Areas - See Map No. 3.

Drainage Area A -

@ South Boundary of 19th Installment.

Area = 603.3 Acres

To determine (T_c) Time of Concentration
Drainage Area is divided into
four reaches.

<u>Reach</u>	<u>Length</u>	<u>Elev. High. Low</u>	<u>Elev. Diff.</u>	<u>T_c</u>
1	1200'	6530-6400	180'	5 min.
2	1000'	6400-6320	80'	6 "
3	3500'	6320-6030	240'	9 "
4	3700'	6030-5896	184'	10 "
Total				$T_c = 30 \text{ min.}$

$$I = 3.44, \quad C = 0.50$$

$$Q = (0.50)(3.44)(603.3) = \underline{1038 \text{ CFS}}$$

@ South Bndry of
Subdivision.

EXISTING CONDITIONS. CONT'D

Drainage Area B.

@ Entrance to Four Hills Arroyo -
See map No. 3

Area = 21.1 Acres

Length of Area = 2800'

Elev. Diff = 6028 - 5857 = 171'

$T_c = 11 \text{ min.}$ $I = 5.25$

$$Q = (0.50)(5.25)(21.1) = \underline{\underline{55 \text{ CFS}}}$$

DRAINAGE AREA C

@ Entrance to Four Hills Arroyo
Near Wagontrain Drive - See map No. 2
and map No. 3.

Area = 117.0 Acres

Drainage Area is divided into 3 reaches

Reach	Length	Elev High - Low.	Elev. Diff	T_c
1	500'	6560 - 6400	160'	3 min
2	4700'	6400 - 5966	434'	12 "
3	2450'	5966 - 5827	139'	6 "

Total $T_c = 21 \text{ min.}$

$I = 3.9$

$$Q = (0.50)(4.1)(117.0) = \underline{\underline{240 \text{ CFS}}}$$

EXISTING CONDITIONS - CONT'D

DRAINAGE AREA D

@ Entrance to Four Hills Arroyo Southwest of Camino Cerrito & Caballero Drive.
Area = 154.6 Acres

Drainage Area is divided into 3 reaches.

Reach	Length	Eleu. High	Eleu. Low	Eleu. Diff	Tc
1	4000'	6330	5968	362	12 min.
2	1800'	5968	5846	122	7 min.
3	1700'	5846	5789	57	6 min.

Total Tc = 25 min.

$$I = 3.9$$

$$Q = (0.50)(3.9)(154.6) = \underline{\underline{301 \text{ CFS}}}$$

DRAINAGE AREA E

@ Entrance of drainage channel in 17th Installment Arroyo at Caballero Rd & Cotton Avenue Intersection.

$$\text{Area} = 41.6 \text{ Acres}$$

$$\text{Length Drainage Area} = 3870'$$

$$\text{Eleu. Diff} = 5896 - 5746 = 150' \quad Tc = 11 \text{ min.}$$

$$I = 5.25$$

$$Q = (0.50)(5.25)(41.6) = \underline{\underline{109 \text{ CFS}}}$$

EXISTING CONDITIONS CONT'D

FLOW RATES IN FOUR HILLS ARROYO

Combined Drainage Areas A, B, A-1 & A-2

@ Wagontrain Drive

$$\text{Area} = 603.3 + 21.1 + 8.3 + 3.4 = 636.1 \text{ Acres}$$

T_c of Area A plus channel flow time

$$= 30 \text{ min} + 2 \text{ min} = 32 \text{ min.}$$

$$I = 3.32$$

$$Q = (0.50)(3.32)(636.1) = \underline{\underline{1056 \text{ CFS}}}$$

Combined Drainage Areas

A, B, A-1, A-2, C & A-3

@ Boundary of 19th Installment & 17th Install.

$$\text{Area} = 636.1 + 117.0 + 7.5 = 760.6 \text{ Acres}$$

T_c = Above t_c plus channel flow time

$$= 32 \text{ min.} + 1 \text{ min} = 33 \text{ min.}$$

$$I = 3.26$$

$$Q = (0.50)(3.26)(760.6) = \underline{\underline{1240 \text{ CFS}}}$$

EXIST. CONDITIONS - CONT'D -

Combined Drainage Areas

A, B, A-1, A-2, C, A-3 & D

@ entrance of flow from drainage Area D.

$$\text{Area} = 760.6 + 154.6 = 915.2$$

$$T_c = \text{Same as above} = 33 \text{ min} - T = 3.26$$

$$Q = (0.50)(3.26)(915.2) = \underline{\underline{1492 \text{ CFS}}}$$

Combined Drainage Areas -

Same as above plus A-4 & E.

@ point where flow from 17th Installment enters Four Hills Arroyo

$$\text{Area} = 915.2 + 8.3 + 41.6 = 965.1$$

$$T_c = \text{Above } T_c + \text{Channel Flow time} =$$

$$= 33 \text{ min} + 2 = 35 \text{ min.}$$

$$I = 3.15$$

$$Q = (0.50)(3.15)(965.1) = 1520 \text{ CFS}$$

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Project FERRY HILLS ADDITION Sheet 7 of 30
19TH INSTALLMENT Job No. 130
By JH Chkd — Date 11-23-73

EXISTING CONDITIONS. CONT'D

Combined Drainage Areas -

Total - A thru E including A-5

Area = 965.1 + 2.9 = 968 - Acres

T_c = Same as above = 35 min.

$I = 3.15$

$Q = (0.50)(3.15)(968) = \underline{\underline{1525 \text{ CFS}}}$

NOTE

See Map No. 3 for Existing Conditions
Flows of areas,

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Project FOUR HILLS Sheet 8 of 30
19TH DISTRICT Job No. 130
By JH. Chkd W Date 11-1-75

DEVELOPED CONDITIONS

Following is the drainage analysis for the proposed developed & improved conditions - (See Map No. 4)

FOUR HILLS - DIVERSION DITCH

See MAP NO 4 for designation & location of Drainage Areas.

Drainage Area (DA) D-3

Area = 5.0 Acres

T_c - less than 10 min - Use $I = 5.4$

$C = 0.50$

$$Q = CIA = (0.50)(5.4)(5.0) = \underline{\underline{13.5 \text{ CFS}}}$$

DA - D-4

Area = 5.5 Ac.

$T_c < 10 \text{ min}$ - Use $I = 5.4$

$$Q = (0.50)(5.4)(5.5) = \underline{\underline{14.8 \text{ CFS}}}$$

DA - D-5

Area = 1.9 Ac. , $I = 5.4$

$$Q = (0.50)(5.4)(1.9) = \underline{\underline{5.1 \text{ CFS}}}$$

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Project FOUR HILLS Sheet 9 of 30
19TH INSTALLMENT Job No. 130
By JA Chkd ✓ Date 11-1-78

DIVERSION DITCH - CONT'D

DA - D-6

Area = 2.7 Acres, $I = 5.4$

$$Q = (0.50)(5.4)(2.7) = \underline{\underline{7.3 \text{ CFS}}}$$

DA - D-7

Area = 4.4 Acres, $I = 5.4$

$$Q = (0.50)(5.4)(4.4) = \underline{\underline{11.9 \text{ CFS}}}$$

DA - D-8

Area = 52.3 Acres

$$E/w, D, ff. = 6330 - 5968 = 382'$$

$$\text{Length} = 4000'$$

$$T_c = 12 \text{ min.} \quad I = 5.0$$

$$Q = (0.50)(5.0)(52.3) = \underline{\underline{130.8 \text{ CFS}}}$$

DA - C-1

Area = 14.7 Acres, $I = 5.4$

$$Q = (0.50)(5.4)(14.7) = \underline{\underline{39.7 \text{ CFS}}}$$

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Project 4-HILLS Sheet 10 of 30
19 Int. IRRIGATION Job No. 13
By JA Chkd — Date 11-1-78

DIVERSION DITCH, CONT'D

DA-C-2

Area = 68.3 Acres

Elev. D.F. = Reach 1 - 6560-6400 = 150'; 49,500'

Reach 2 - 6400-5966 = 434'; 49,4700'

T_c = Reach 1 = 3 min.

Reach 2 = 12 min.

Total = 15 min, $T = 4.6$

$Q = (0.50)(4.6)(68.3) = \underline{\underline{157.1 \text{ CFS}}}$

DA-B-1

Area = 7.0 Acres, $I = 5.4$

$Q = (0.50)(5.4)(7.0) = \underline{\underline{18.9 \text{ CFS}}}$

DIVERSION DITCH — FLOW ANALYSIS

Flows from Drainage Areas D-3 through D-8, C-1 & C-2 and B-1 will be intercepted by the FOUR HILLS DIVERSION CHANNEL.

DA - D-3 - See Sheet 8

$$Q = \underline{\underline{13.5 \text{ CFS}}}$$

DA - D-3 & D-4

$$\text{Area} = 5.0 + 5.5 = 10.5 \text{ Acres,}$$

$$I = 5.4$$

$$Q = (0.50)(5.4)(10.5) = \underline{\underline{28.4 \text{ CFS}}}$$

DA - D-3, D-4 & D-5

$$\text{Area} = 10.5 + 1.9 = 12.4 \text{ Acres}$$

$$I = 5.4$$

$$Q = (0.50)(5.4)(12.4) = \underline{\underline{33.5 \text{ CFS}}}$$

DA - D-3 thru D-6

$$\text{Area} = 12.4 + 2.7 = 15.1 \text{ Acres}$$

$$T_c < 10 \text{ min. Use } I = 5.4$$

$$Q = (0.50)(5.4)(15.1) = \underline{\underline{40.8 \text{ CFS}}}$$

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Project FOUR HILLS Sheet 12 of 30
19TH INSTALLMENT Job No. 150
By J.M. Chkd ✓ Date 11-1-73

DIVERSION DITCH CONT'D

DA - D-3 THRU D-7

$$\text{Area} = 15.1 + 4.4 = 19.5 \text{ Acres}$$

$$I = 5.4$$

$$Q = (10.50)(5.4)(19.5) = \underline{\underline{52.6 \text{ CFS}}}$$

DA - D-3 THRU D-8

$$\text{Area} = 19.5 + 52.3 = 71.8 \text{ Acres}$$

$$T_c = \text{Same as for Drainage Area D-3} \\ = 12 \text{ min.}$$

$$I = 5.0$$

$$Q = (10.50)(5.0)(71.8) = \underline{\underline{179.5 \text{ CFS}}}$$

DA - D-3 THRU D-8 & C-1

$$\text{Area} = 71.8 + 14.7 = 86.5 \text{ Acres}$$

$$T_c = \text{Same as above} - 12 \text{ min.} + \text{channel} \\ \text{flow time.}$$

$$\text{Channel flow time} = 900' @ 5 \text{ fps} = 3 \text{ min.}$$

$$T_c = 12 \text{ min} + 3 \text{ min.} = 15 \text{ min.}$$

$$I = 4.6$$

$$Q = (10.5)(4.6)(86.5) = \underline{\underline{199.0 \text{ CFS}}}$$

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Project El Jeco Hills Sheet 13 of 30
19TH INSTALLED UNIT Job No. 1310
By Jed Chkd ✓ Date 11-1-78

DIVERSION DITCH CONT'D

DA - D-3 thru D-8 & C-1 & C-2.

Area = $86.5 + 68.3 = 154.8$ Acres

T_c = Same as above which is equal
to T_c for Drainage Area C-2.

= 15 min.

$I = 4.6$

$Q = (10.50)(4.6)(154.8) = \underline{\underline{356.0 CFS}}$

DA - D-3 thru D-8, C-1 & C-2 & B-1

Area = $154.8 + 7.0 = 161.8$ Acres

T_c = Same as above - 15 min. + channel
flow time.

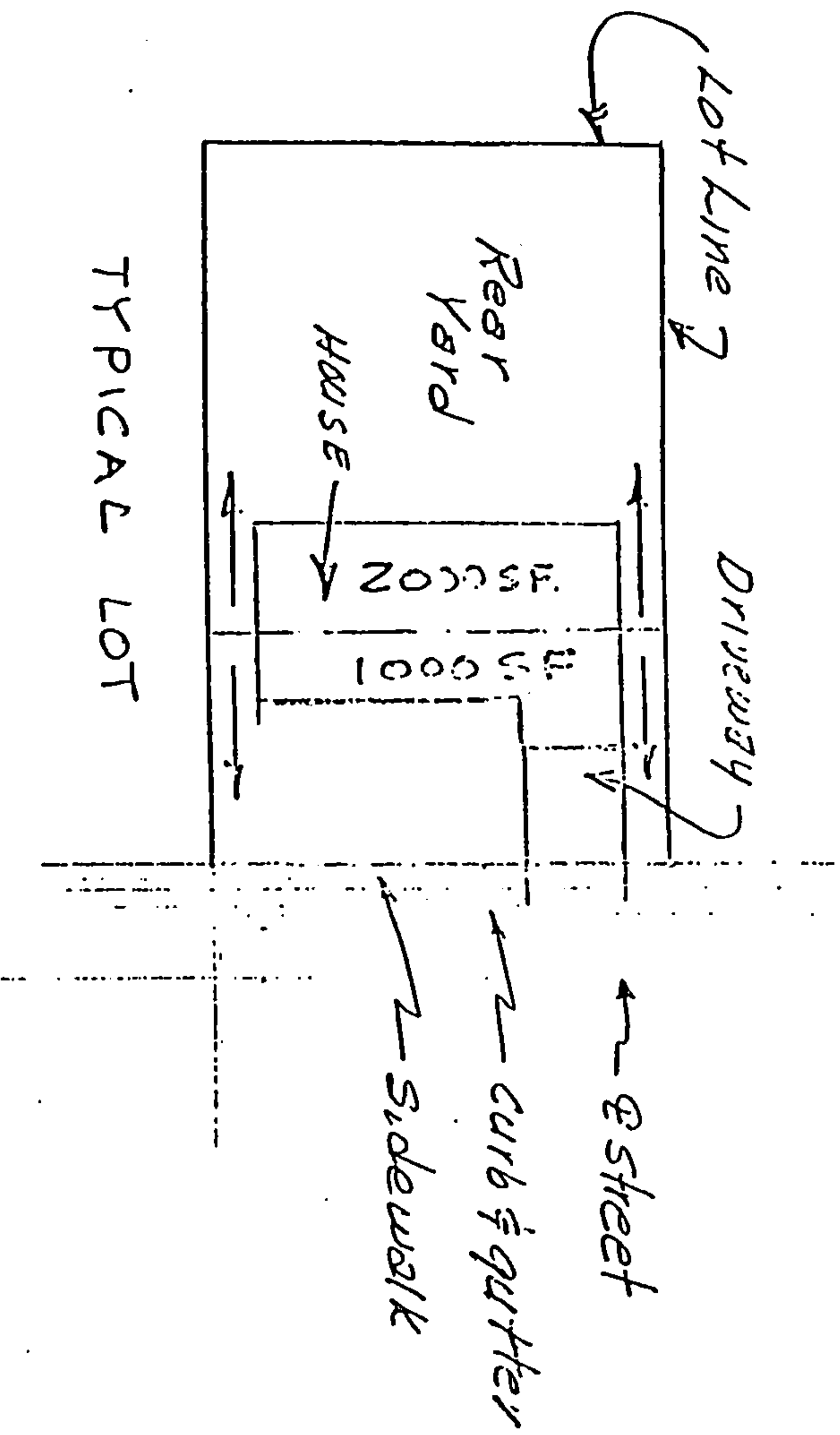
Channel flow time = 700' @ 6 fps = 2 min.

$T_c = 15 \text{ min} + 2 \text{ min} = 17 \text{ min.}$

$I = 4.5$

$Q = (10.50)(4.5)(161.8) = \underline{\underline{364.0 CFS}}$

DEVELOPED CONDITIONS



TYPICAL LOT

Runoff Factors.

Front Yard & Street Area.

Paved Area =	100 x 16.62	1662 sq ft
Street Area =	100 x 4 + 4 x 25 =	500
Sidewalk Area =	20 x 29.38	588
Driveway Area =		2750 sq ft

Roof Area

Total Hard Surface

Total Area =	75 x 100 =	7500 sq ft
Hard Surface =	$\frac{3750}{7500} =$	50%
Land Scaped Area =	100 - 50 =	50%
Runoff Factor =	(0.50)(0.70) + (0.50)(0.40)	
	=	<u>0.65</u>

Rear Yard

$$\text{Roof Area} = 25 \times 80 = 2000 \text{ ft}^2$$

$$\text{Total Area} = 100 \times 110 = 11,000 \text{ ft}^2$$

$$\text{Hard Surface} = \frac{2000}{11,000} = 13\%$$

$$\text{Land Covered} = 100 - 13 = 82\%$$

$$\text{Runoff Factor} = (0.13)(0.30) + (0.82)(0.35) \\ = \underline{\underline{0.315}}$$

Ponding Volume

$$V = \text{Rear Yard Area} \times 0.43 \times 2.7' / 12 =$$

$$V = \underline{\underline{\text{Rear Yard Area} \times 0.103 \text{ ft}^3/\text{ft}^2}}$$

NOTE

Due to the steep terrain on which this subdivision is located ponding cannot be accomplished on some lots. However, in considering the total subdivision sufficient ponding shall be provided so as not to increase the volume & rate of runoff due to development.

DEVELOPED CONDITIONS- CONT'D

Following is the drainage analysis of the areas below the diversion ditch.

DRAINAGE AREA C

Flows on Shalo's Drive @ Wagontrain.

Area of drainage = 9.8 Acres.

Portion of area having a 0.65 runoff factor = 6.9 Acres - front yard.

Portion of area having a 0.48 runoff factor = 2.9 Acres - Rear yard.

$T_c < 10$ min. Use $I = 5.4$

$$Q = (0.65)^{24.2} (5.4) (6.9) + (0.48)^{7.5} (5.4) (2.9) = \underline{\underline{31.7 \text{ CFS}}}$$

Flows on La Cebra (Wagontrain) @ Shalo's Dr.

Area = 33.5 Acres, $I = 5.4$, $C = 0.50$

$$Q = (0.50) (5.4) (33.5) = \underline{\underline{90.5 \text{ CFS}}}$$

Flows on Wagontrain Drive @ drainage structure of Four Hills Area

Area = 33.5 Ac - @ $C = 0.5$, 8.6 Ac @ $C = 0.65$
2.9 Ac @ $C = 0.48$ - TOTAL AREA = 45 Acres

$$Q = 5.4 [33.5 \times 0.5 + (8.6 \times 0.65) + (2.9 \times 0.48)] = \underline{\underline{128.1 \text{ CFS}}}$$

DEVELOPED CONDITIONS - CONT'D

DRAINAGE AREA D

Flows on Ranch Trail @ Camino Cerrito

Area = 3.6 Acres $T_c < 10 \text{ min} - I = 5.4$

$$Q = (0.65)(5.4)(3.6) = \underline{\underline{12.6 \text{ CFS}}}$$

Flows on Camino Cerrito @ Caballero Drive

Portion of area having a runoff factor
of 0.50 = 66.6 Acres

Portion of area having a runoff factor
of 0.65 = 6.1 Acres

Drainage Area is Divided into 2 Reaches

Reach	Length	Elev High Low	Elev. Diff.	T_c
1	900'	6230-5930	300'	4 min.
2	4280'	5930-5804	126'	14 min

TOTAL $T_c = 18 \text{ min.}$

$$I = 4.4$$

$$Q = 4.4 [(0.50 \times 66.6) + (0.65 \times 6.1)] = \underline{\underline{164 \text{ CFS}}}$$

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Project FOUR HILLS VILLAGE Sheet 18 of 30
19TH INSTALLMENT Job No. 130
By Jif Chkd — Date 11-28-78

DRAINAGE AREA D. CONT'D.

Flows on Caballero Drive @ Camino Cerro

Area = 2.0 Acres I = 5.4

$$Q = (0.65)(5.4)(2) = \underline{\underline{7.0 \text{ CFS}}}$$

TOTAL FLOW @ Intersection of Camino
Cerro & Caballero Drive

Area = 66.6 Acres @ $C=0.50$ 8.1 Acres @ $C=0.65$

$I = 4.4$ - See previous sheet

$$Q = 4.4 [(0.50 \times 66.6) + (0.65 \times 8.1)] = \underline{\underline{169.7 \text{ CFS}}}$$

Drainage Area E.

Flows on Conestoga Drive Cul de Sac
@ North End.

Area = 2.5 Acres $I = 5.4$

$$Q = (0.65)(5.4)(2.5) = 8.8 \text{ CFS}$$

Flows on Conestoga Drive @ Wagontrain.

Area = 3.0 Acres $I = 5.4$

$$Q = (0.65)(3.0)(5.4) = \underline{\underline{10.5 \text{ CFS}}}$$

Flow on Wagontrain Drive @ West
Boundary & Subdivision.

Area = 4.7 Acres $I = 5.4$

$$Q = (0.65)(5.4)(4.7) = \underline{\underline{16.5 \text{ CFS}}}$$

Flow at Entrance to Four Hills Arroyo Rd
in 17th Installment North of Castellano Rd
& Cotton Avenue Intersection

Area = 29.8 Ac. @ $C = 0.50$, 4.7 Ac. @ $C = 0.65$

Use $I = 5.25$ (See Sheet 4)

$$Q = 5.25 [(0.50 \times 29.8) + (0.65 \times 4.7)] = \underline{\underline{94.3 \text{ CFS}}}$$

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Project FOUR HILLS WILLAGE Sheet 20 of 30

19TH INSTALLMENT

Job No. 130

By JA

CHK'd

Date 11-28-78

DEVELOPED CONDITIONS CONT'D

FOUR HILLS ARROYO

Drainage Area A.

Flow @ South Boundary of Subdivision

Area = Drainage Area A Plus Area
diverted by Diversion Ditch.

Area = 603.3 Ac + 161.8 Acres = 765.1 Ac.

$I = 3.44$. (See Sheet 2)

$Q = (0.50)(3.44)(765.1) = \underline{\underline{1316 \text{ CFS}}}$

Flow @ South Side of Wagontrain Dr.

Area = 765.1 + 3.0 = 768.1 Ac.

$I = 3.32$ (See Sheet 5)

$Q = (0.50)(3.32)(768.1) = \underline{\underline{1275 \text{ CFS}}}$

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Project FOUR HILLS WILLAGES Sheet 21 of 30
19TH INSTALLMENT Job No. 130
By L.H. Chkd ✓ Date 11-29-73

DEVELOPED CONDITIONS - CONT'D

FOUR HILLS AREA

Flows @ Boundary of 19TH Installation
& 17TH Installation.

Area = $768.1 + 2.7 = 770.8 \text{ Ac.} + 45 \text{ Ac.}$ Drainage Area C

Runoff Factor - Drainage Area C = 0.53

$T_c = 33 \text{ min.}$ $I = 3.26$. See Sheet 5

$$Q = 3.26 [(0.50 \times 770.8) + (0.53 \times 45)] = \underline{\underline{1334 \text{ CFS}}}$$

Flows @ Entrance of flow from Drainage
Area D (From Camino Cerro to Caballero Dr.)

Area = 770.8 Ac + Drainage Areas C (45 Ac.) & D (74.74 Ac.)

Runoff Factor - Drainage Area D = 0.52

$I = 3.26$ - Same as above

$$Q = 3.26 [(0.50 \times 770.8) + (45 \times 0.53) + (74.7 \times 0.52)] \\ = \underline{\underline{1461 \text{ CFS}}}$$

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Project FOUR INCH WELLS Sheet 22 of 30

1ST INSTALLMENT Job No. 130

By JA Chkd — Date 11-29-73

Flows @ Bernalillo Place SE.

@

Area = 770.8 Ac + 8.3 + 2.9 = 782 CFS

Plus Drainage Area C = 45 Ac.

Drainage Area D = 74.7 Ac.

Drainage Area E = 34.5 Ac.

17th Installment Drainage = 29.8 Ac.

From 19th Installment = 4.7 Ac.

Runoff Factor = 0.52 -

-Use I. = 3.26 - Same as above.

$Q = 3.26 [(0.50 \times 782) + (0.53 \times 45) + (0.52 \times 74.7 + 34.5)]$

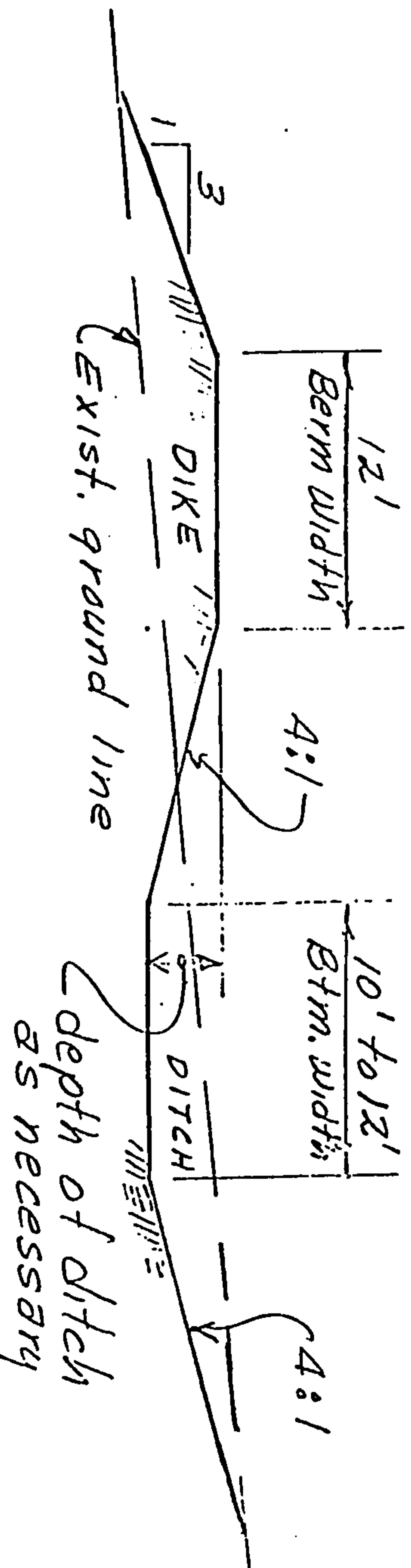
Q = 1538 CFS

FACILITY DESIGN

FOUR HILLS DIVERSION DITCH

Design Concept:

1. Earth Channel
2. Low velocities - Flat Slope -
3. Provide relatively flat side slopes on ditch to enhance vegetation growth & to minimize erosion.



TYPICAL SECTION

Ditch flows @ various depths - (d)

Use ditch flowline grade of 0.25%

Use $n = 0.030$

$d = 1.0 \text{ ft.}$ 10' bottom width of ditch

$$V = \frac{1.486}{n} R^{2/3} S^{1/2} = \frac{1.486}{0.030} (R^{2/3}) (0.0025)^{1/2}$$

$$V = 49.53 (R)^{2/3} (0.05). \quad R = \frac{A}{wP} = \frac{14}{18.24} R^2$$

$$V = 49.53 (0.84) (0.05) = 2.08 \quad Q = 2.08 \times 14 = \underline{29.1 \text{ cfs}}$$

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Project FOUR HILLS WILLOWES Sheet 24 of 30
19TH INSTALLMENT Job No. 130
By J.A. Chkd — Date 11-29-73

FACILITY DESIGN

FOUR HILLS DIVERSION DITCH

TABULATION - DITCH FLOW RATES
Ditch Grade = 0.25%

Ditch Estm. width	Depth of flow - FT.	Velocity FPS	Q CFS
10'	1.0'	2.08	29.1
10'	1.5'	2.60	62.3
12'	1.0'	2.12	33.9
12'	1.25'	2.40	51.0
12'	1.5'	2.65	71.6
12'	2.0	3.10	124.0
12'	2.5'	3.51	193.0
12'	3.0'	3.88	279.2
12'	3.5'	4.22	384.3
12'	4.0'	4.55	509.5
Ditch Grade = 0.30%			
12'	2.5	3.84	211.2
12'	3.0	4.25	306.0
12'	3.5	4.62	420.4

NOTE: Provide desilting basins @ entrance
of larger flow to the diversion ditch.

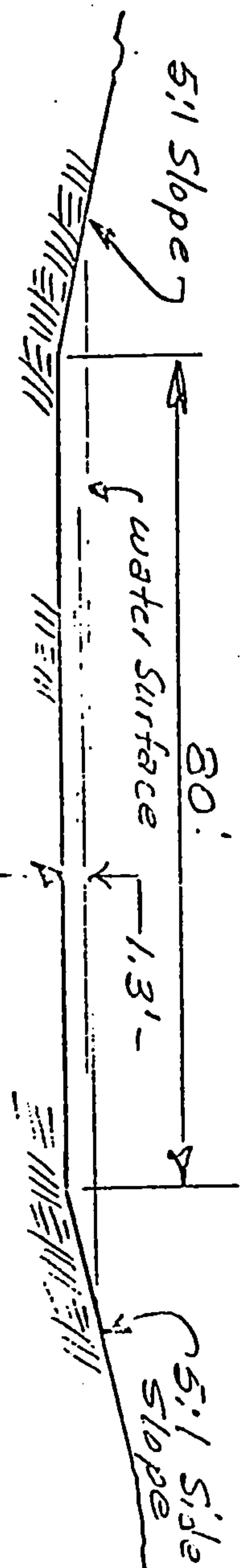
FACILITY DESIGN

FOUR HILLS ARROYO

Existing Arroyo Channel Characteristics

Required Capacity - Upstream of Deposition.
= 1316 CFS - See Sheet 20

Average width of Channel = 80'
Average Channel side slope = 5:1
Average - Slope of Flowline = 5.3%



Use depth of water = 1.3 ft, $n = 0.030$

$$\text{Area} = 1.3 \times 80 + 1.3 \times 6.5 = 112.5 \text{ ft}^2$$

$$\text{WP} = 93.25' \quad R = \frac{112.5}{93.25} = 1.206$$

$$V = \frac{1.486}{n} R^{2/3} S^{1/2} = \frac{1.486}{0.030} (1.133)^{2/3} (1.053)^{1/2}$$

$$V = 12.9 \text{ fps}$$

$$Q = AV = 112.5 \times 12.9 = \underline{1451 \text{ CFS}} \quad \text{OK}$$

depth of flow will average
slightly less than 1.3 ft.

NOTES

Provide bank protection @ sides of
arroyo to maintain straight & even flow.

FACILITY DESIGN

FOUR HILLS ARROYO

DRAINAGE STRUCTURE -

Four Hills Arroyo @ downstream Drive

From previous sheet - Channel
entrance velocity = 12.9 cfs

$$\begin{aligned} \text{Required Opening Area of Structure} \\ = \frac{1316 \text{ cfs}}{12.9} = 102 \text{ ft}^2 \end{aligned}$$

Use 5-60" RCP.

$$\text{open Area} = 2.5^2 \pi \times 5 = 98.17 \text{ ft}^2$$

NOTES

1. Design inlet of structure to increase velocity slightly -
2. Provide channel erosion protection upstream & downstream of structure.

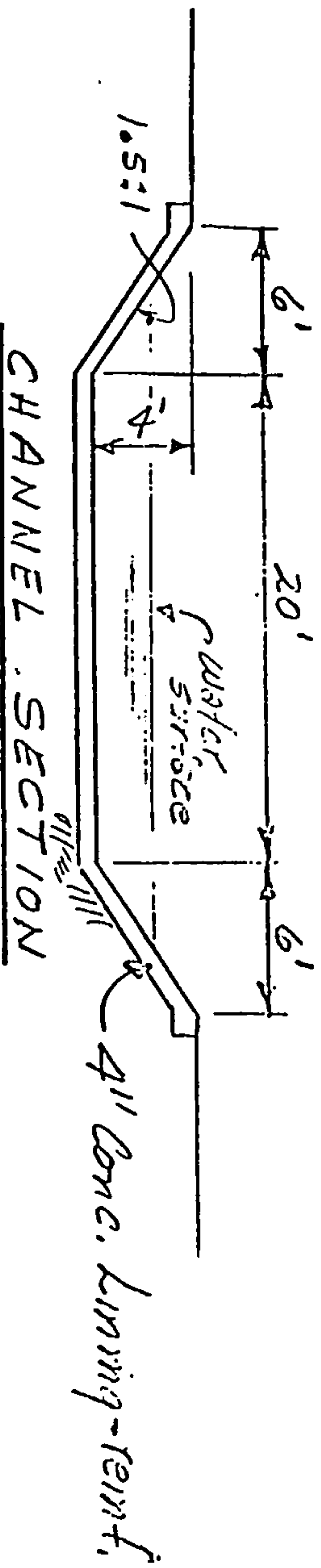
FACILITY DESIGN

FOUR HILLS VILLAGE

Concrete lined Channel

Required Capacity @ Inlet = 1334 CFS
(see sheet 21)

Design channel for 1461 CFS - (see sheet 21)
& for 1538 CFS - (see sheet 22)



Assume channel slope = 4.20% min.
depth water = 2.2 ft. $n = 0.015$

$$\text{Area} = 2.2 \times 20 + 2.2 \times 3.3 = 51.26 \text{ ft}^2$$

$$WP = 27.93 \quad R = \frac{51.26}{27.93} = 1.835$$

$$V = \frac{1.486}{n} R^{2/3} S^{1/2} = \frac{1.486}{0.015} (1.835)^{2/3} (.042)^{1/2}$$

$$V = 30.44 \text{ fps}$$

$$Q = AV = 51.26 \times 30.44 = 1560 \text{ CFS} - \text{OK}$$

> 1461 & 1538

NOTES

1. Provide erosion protection @ inlet to conc. lining
2. Provide transition structure @ end of concrete lining & entrance to triangle constructed by city.

FACILITY DESIGN

Camino Cerrito @ Cobalt Drive

$Q = 164$ CFS. See Sheet 17

This flow exceeds capacity of existing street.

Solution:

Remove existing paving from north boundary of the 19th Installment north to Speakman Drive. Replace with inverted crown street.

Capacity of Inverted Crown Street

$$n = 0.015 \quad \text{Slope} = 0.60\%$$

$$\text{Area} = 28 \times 17 + 32 \times 0.67 = 26.2 \text{ ft}^2$$

$$WP = 33.3$$

$$R = \frac{26.2}{33.3} = 0.852$$

$$V = \frac{1.486}{0.015} (1.852)^{1/2} = 6.54$$

$$Q = 26.2 \times 6.54 = 171.3 \text{ CFS} > 164 \text{ CFS}$$

NOTE

Under high flows in Camino Cerrito there will be some spill over the water block on Speakman Drive as the water block is only 4" high. This will provide some reduction in flow on Camino Cerrito.

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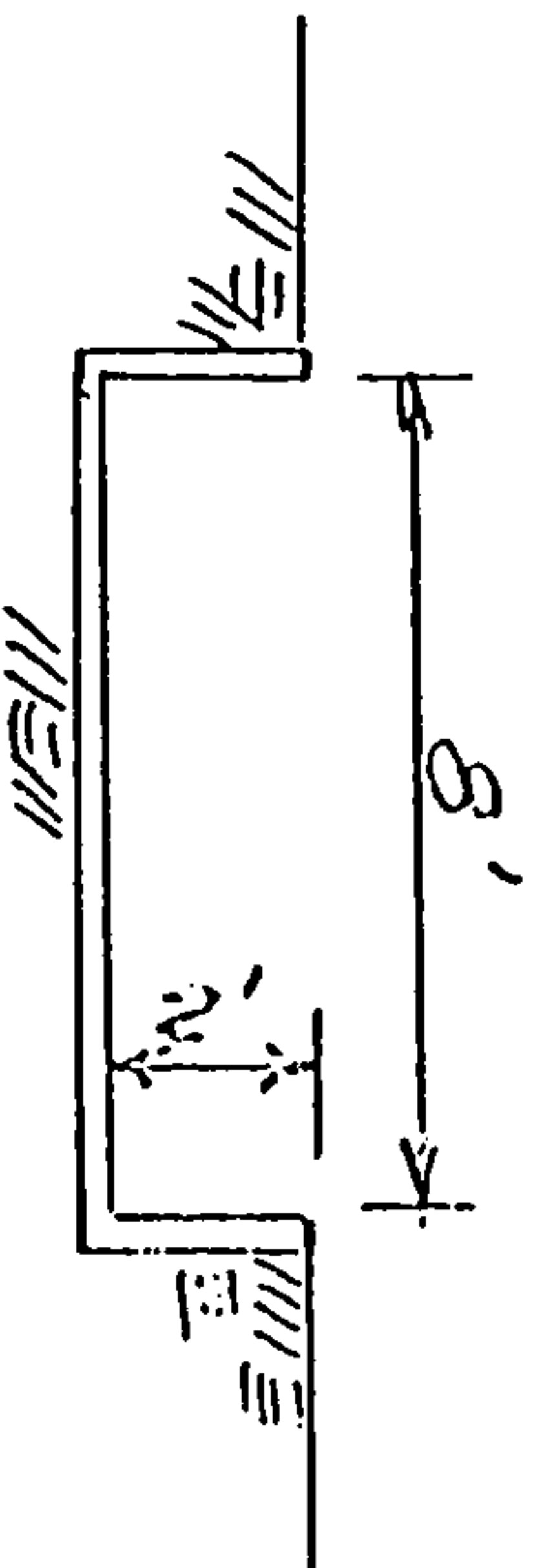
Project EDUARDO HILLS VILLAGE Sheet 29 of 30
19TH INSTALLMENT Job No. 150
By LL Chkd — Date 11-29-73

FACILITY DESIGN

Drainage easement Channel
Lots 43 & 44 - Block 17-A &
Outlet Channel - Camino Cerrito & Caballero Dr.

$$Q = 169.7 \text{ cfs}$$

Use concrete Channel @ 2% grade



$$\text{depth of flow} = 1.5' \quad n = 0.015$$

$$V = \frac{1.486}{0.015} \times \left(\frac{12}{11}\right)^{4/3} (0.02)^{1/2} = 14.84 \text{ ft/sec}$$

$$Q = AV = (1.5 \times 8) (14.84) = \underline{178 \text{ cfs}} \quad \text{OK}$$

> 169.7

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Project FORD HILLS WILLOW Sheet 30 of 30
100' WATER ALIGNMENT Job No. 130
By JA Chkd ✓ Date 11-29-73

FACILITY DESIGN

Conestoga Drive Cul de Sac.

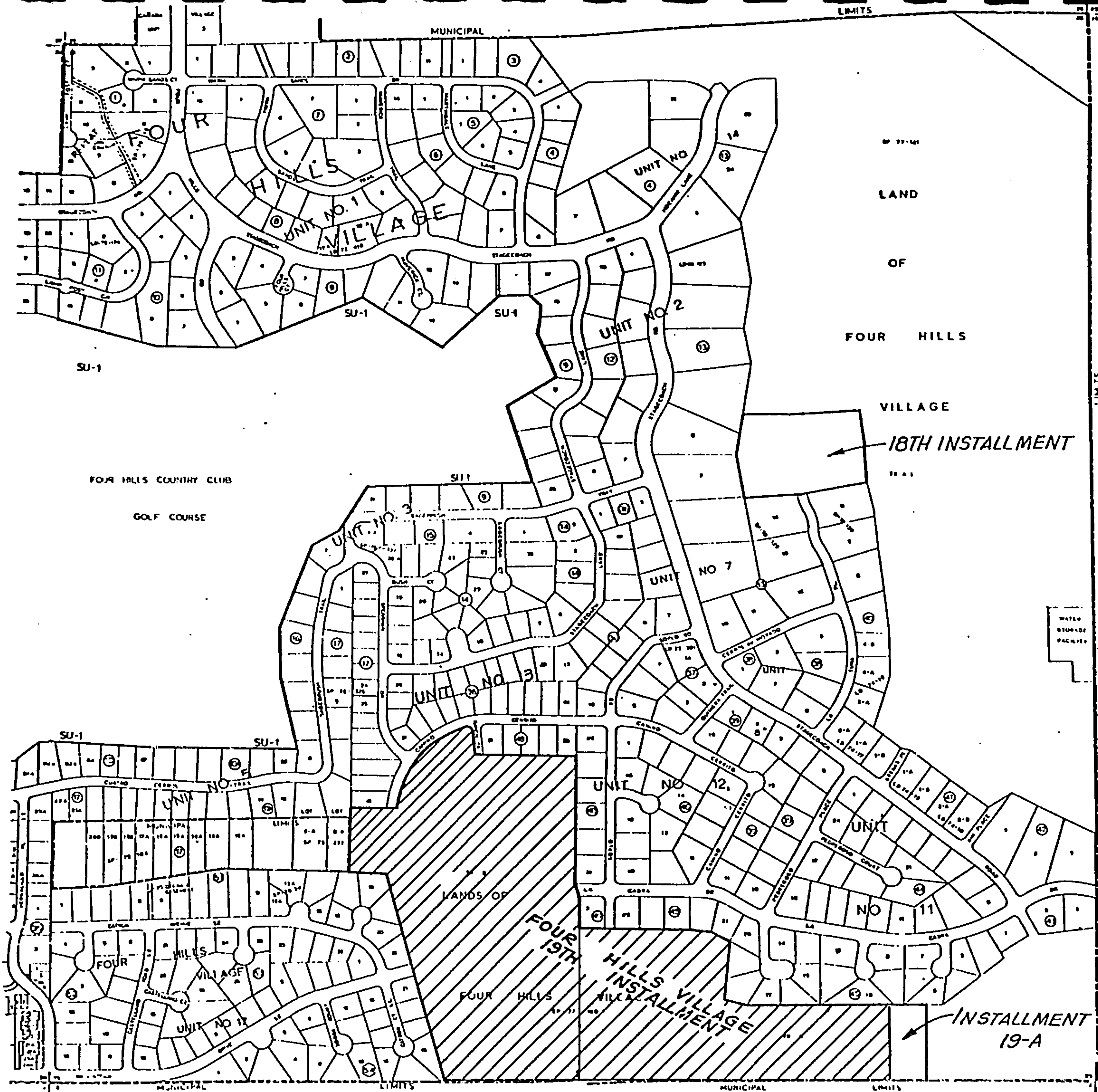
Drainage Easement Storm Sewer
LOTS 39 & 40, Block 54. A

Q = 8.8 cfs See Sheet 19

Use - 1- Drop Inlet, Double "C"

Use - 18" RCP outfall line @ 1.6%

Capacity = 12 cfs ok
> 8.8



FOUR HILLS VILL. 19TH INSTALLMENT DRAINAGE ANALYSIS

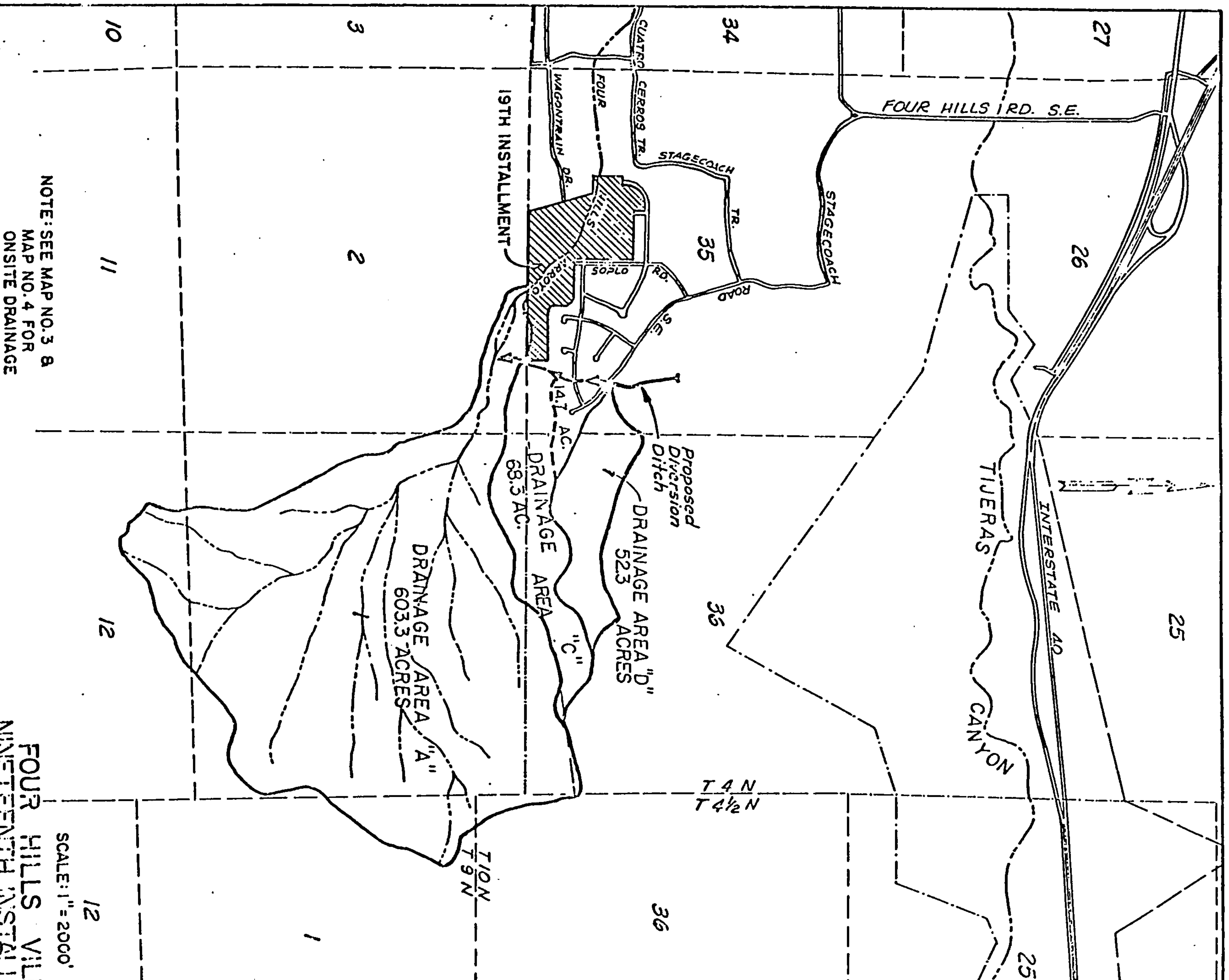
LEGAL DESCRIPTION
P. 10. 11
P. 10. 12
P. 10. 13
P. 10. 14

UNIFORM PLANNING CODE
P. 10. 15

MAP AMENDED THROUGH
APRIL 1971

LOCATION MAP
M-23-7

MAILED 11/1

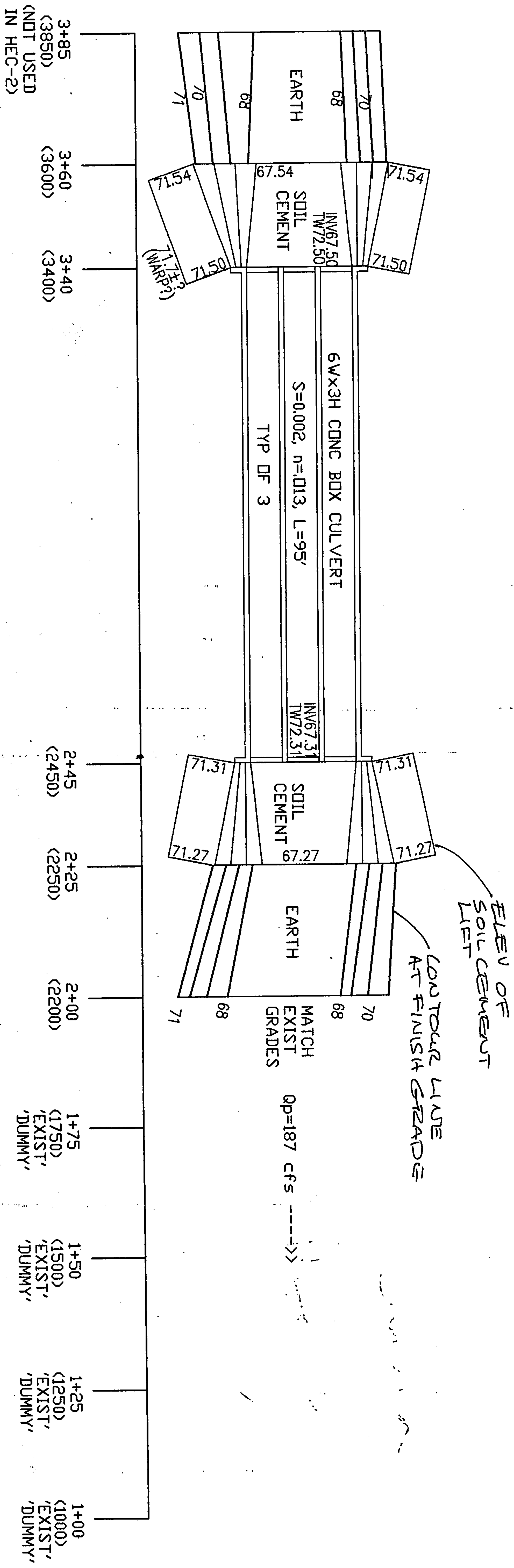


NOTE: SEE MAP NO. 3 &
 MAP NO. 4 FOR
 ONSITE DRAINAGE

**FOUR HILLS VILLAGE
 NINETEENTH INSTALLMENT
 DRAINAGE ANALYSIS
 OFFSITE DRAINAGE**

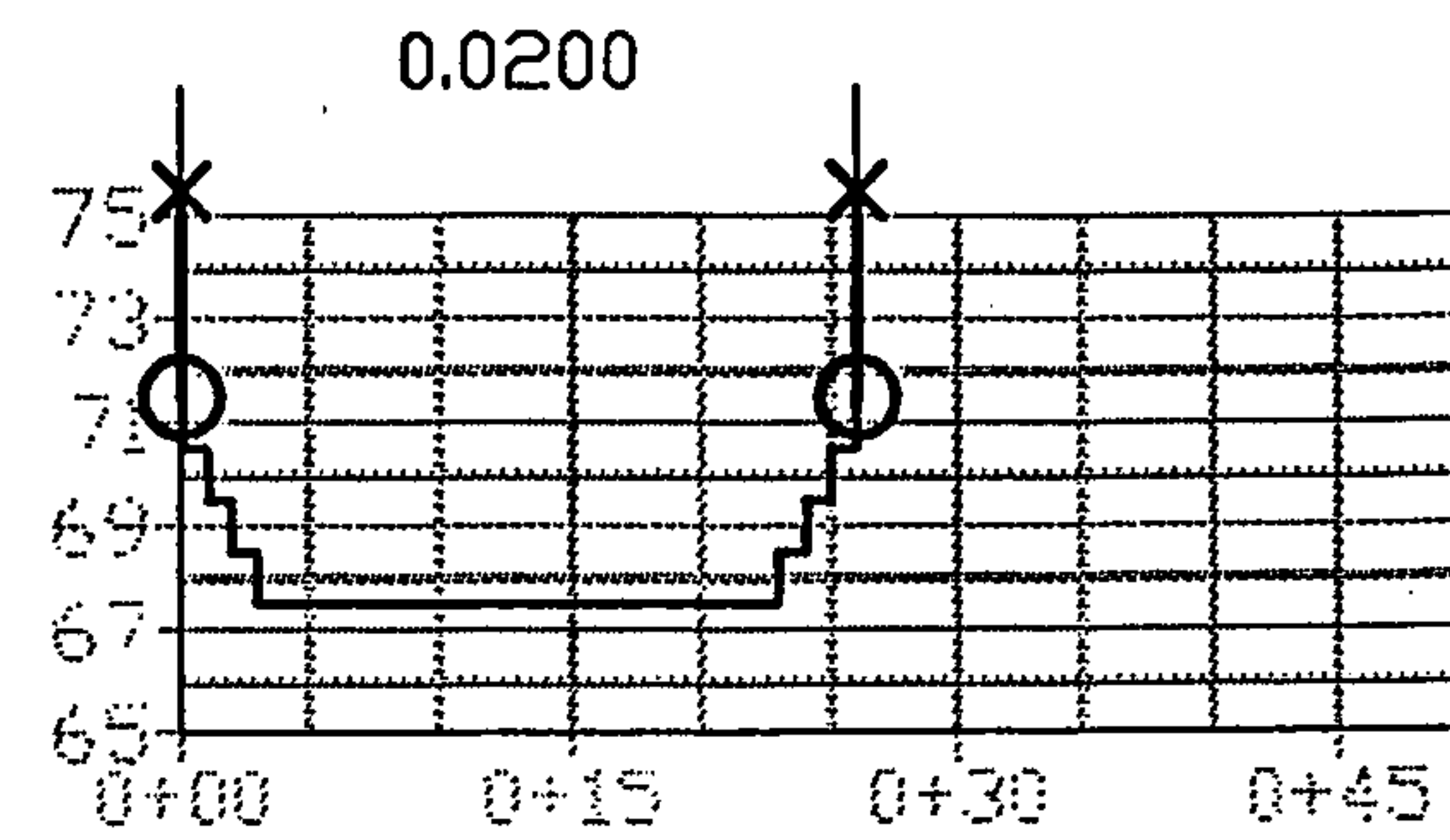
SCALE: 1" = 2000'

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 ALBUQUERQUE, NEW MEXICO

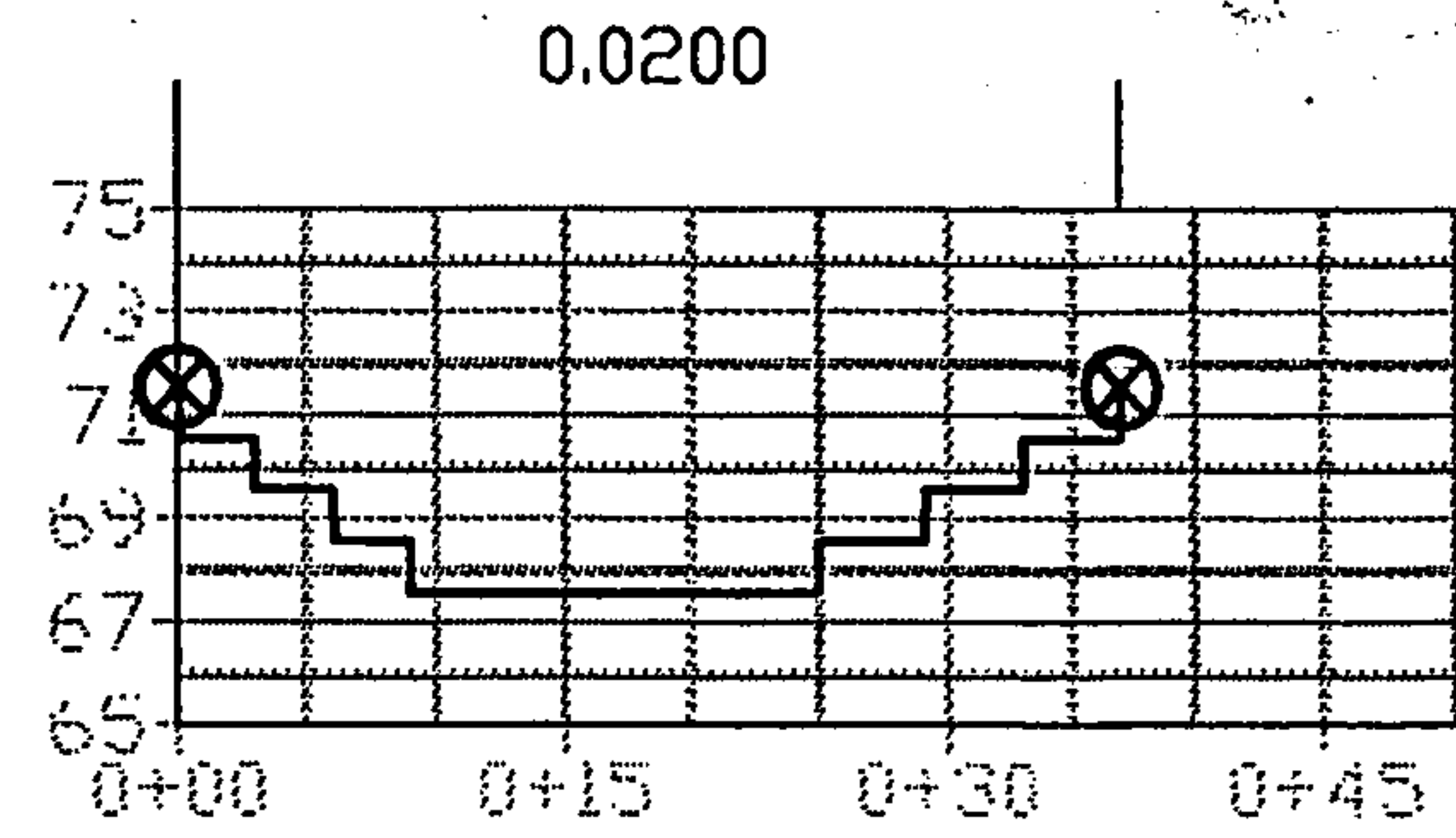


LAYOUT & HEC-2 STATIONING
 RON JOHNSON BOX CULVERTS AT 4 HILLS DIVERSION CHANNEL
 DWG: C:\ACAD\AH2\RONJH2A DATE: 06/26/97 TIME: 09:47 T. GREEN

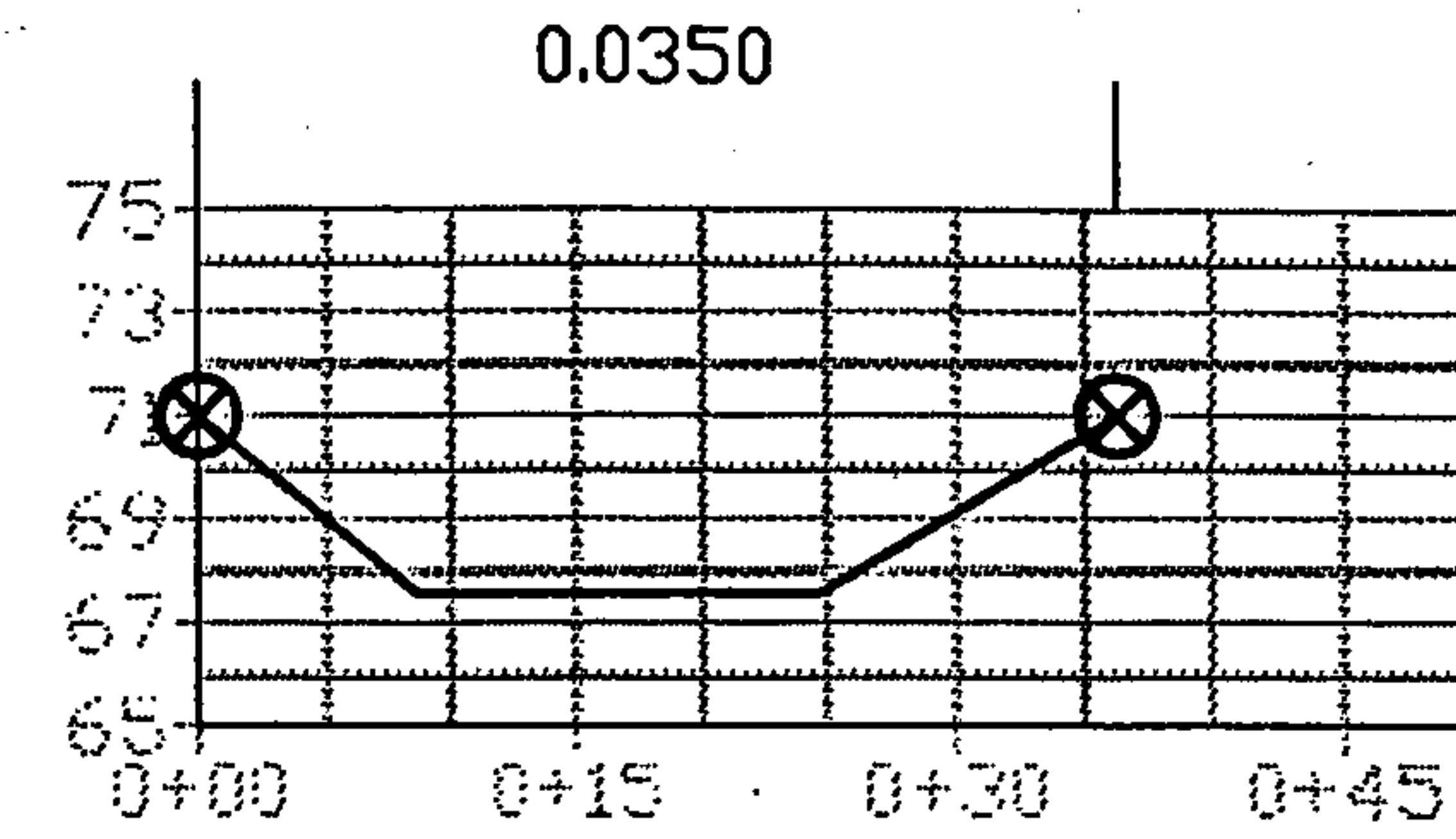
Figure 1



3400
UPSTR FACE OF CULVERT



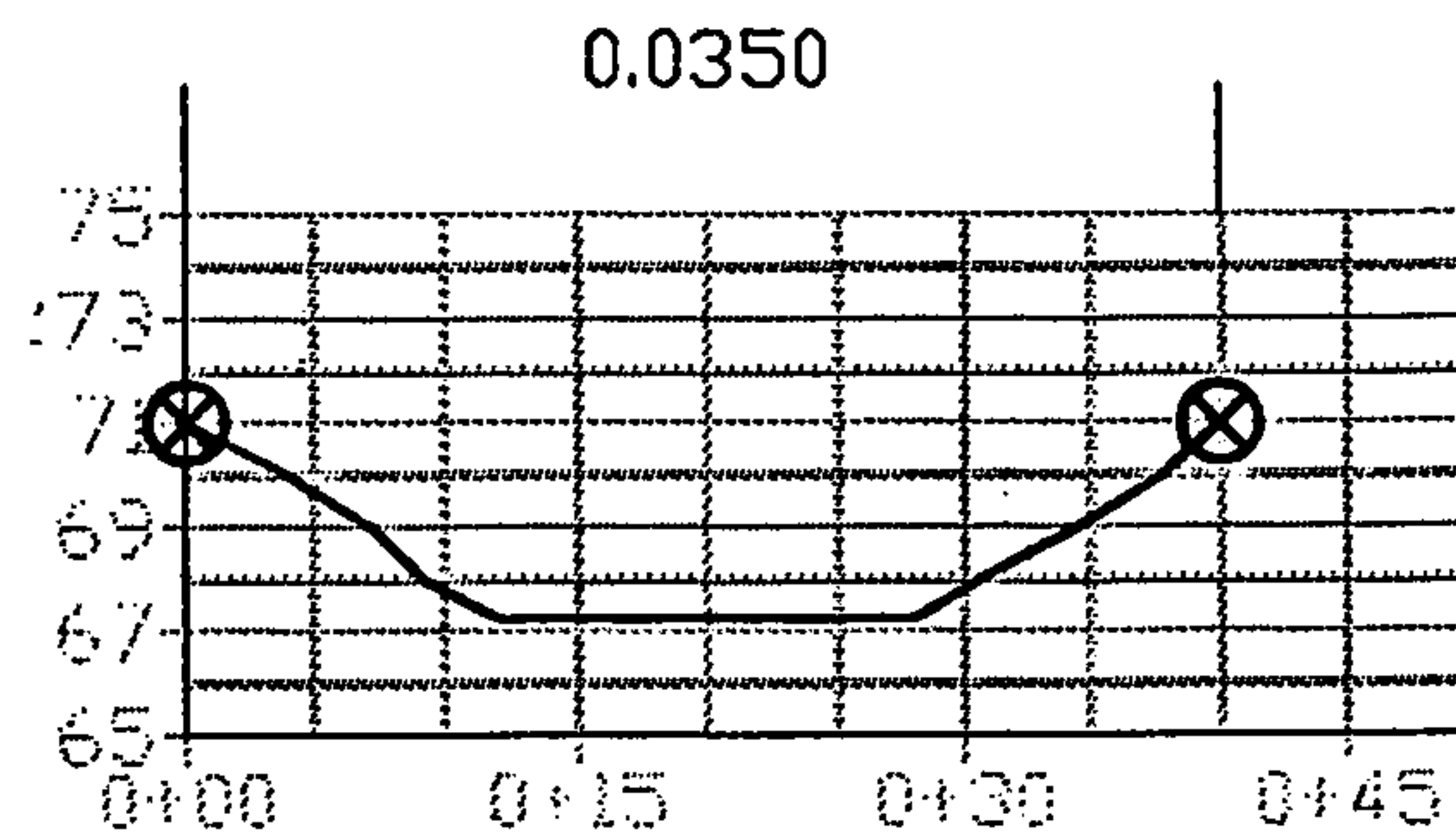
3600
UPSTR END SOIL CEMENT APRON



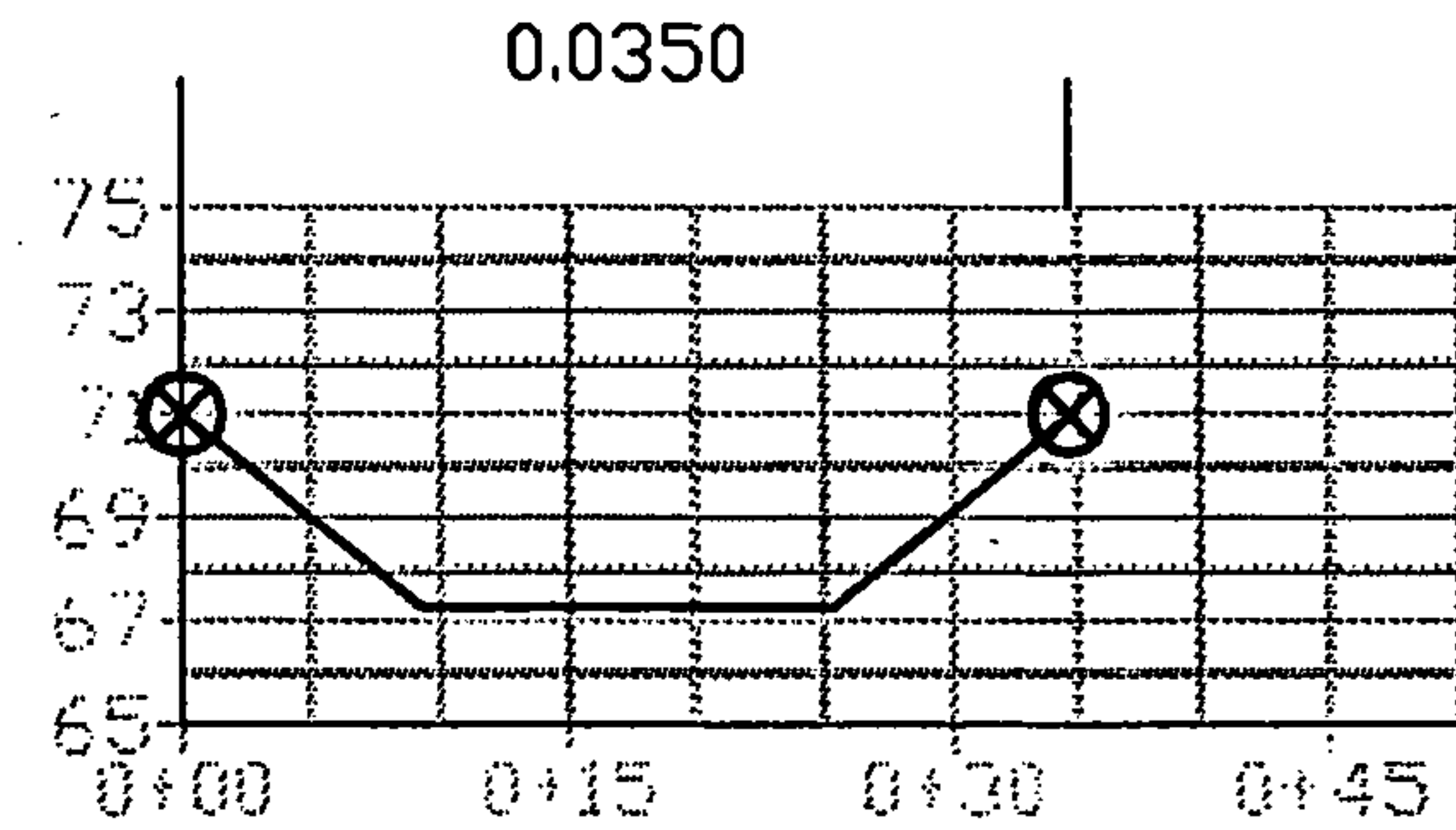
3601
DIRT, 0.1' UP FROM SOIL CEMENT

EXISTING "DUMMY" SECTIONS FOR
B=16, SS=3H:1V, n=.035, S=0.002
FILE RONJH2A.DWG OR .DAT

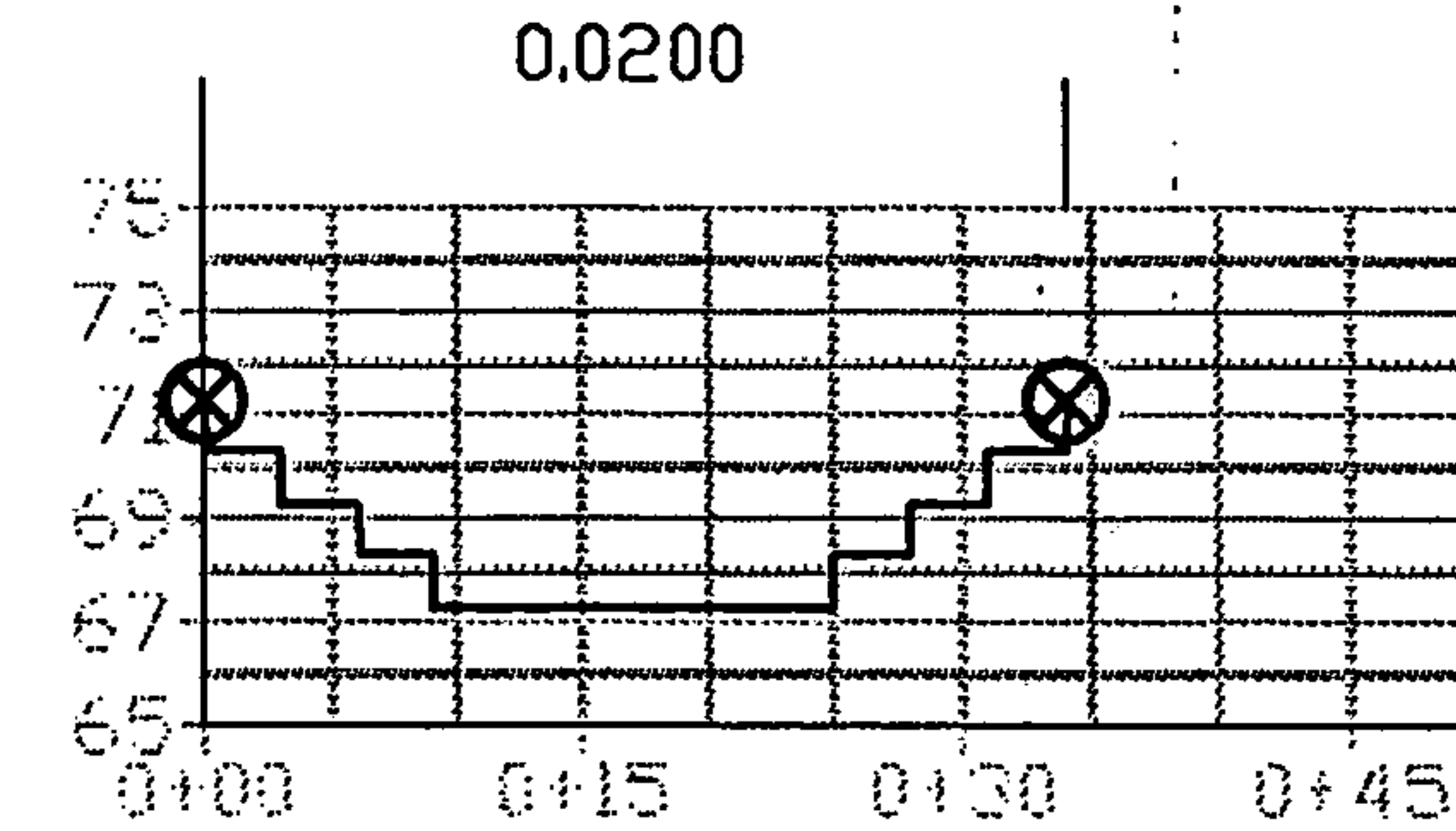
- SECTIONS SHOWN FOR INFORMATION ONLY
- SEE HEC-2 OUTPUT FOR DEPTHS & VELOCITIES



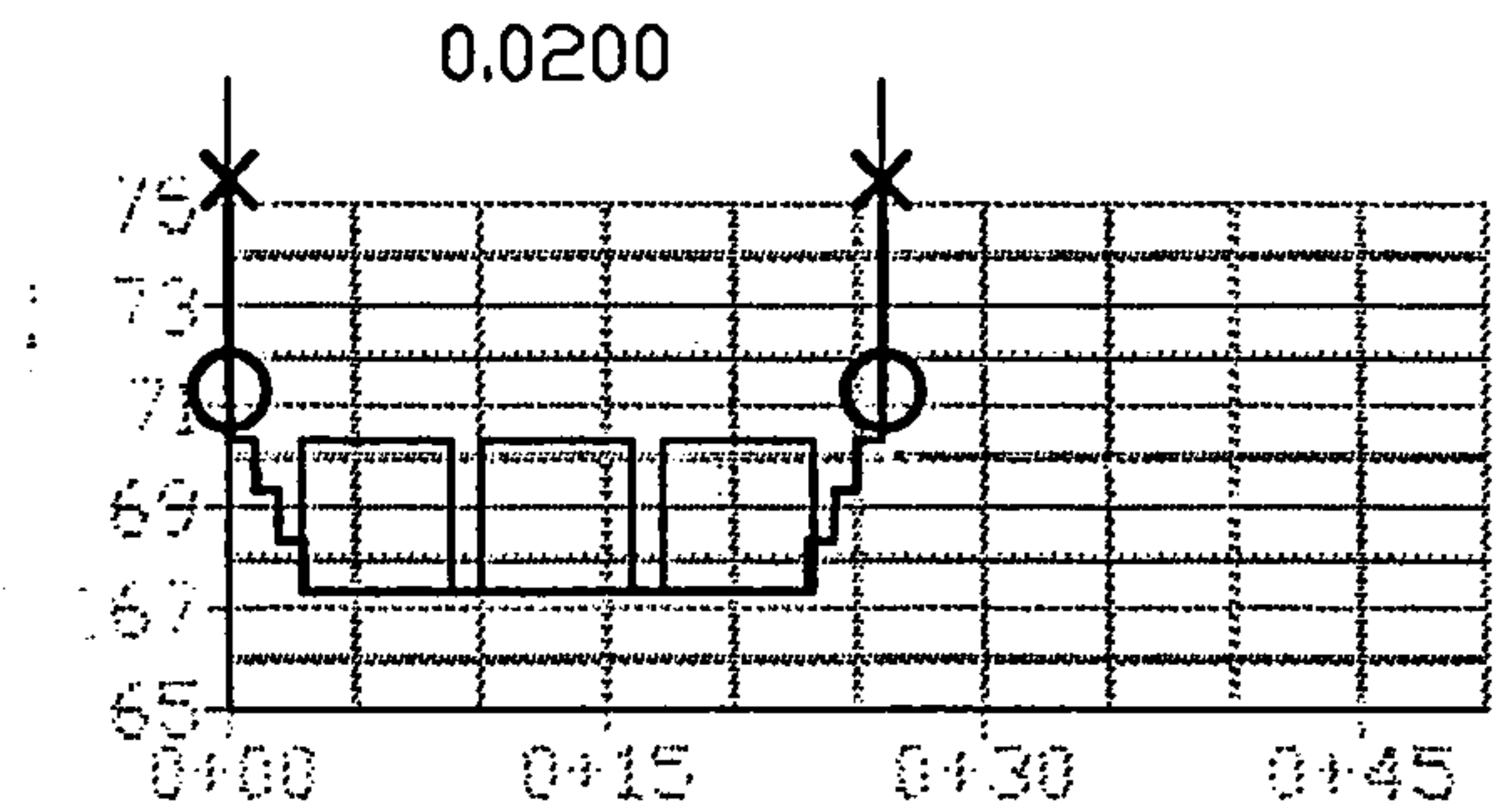
2000
TIE TO EX BANKS



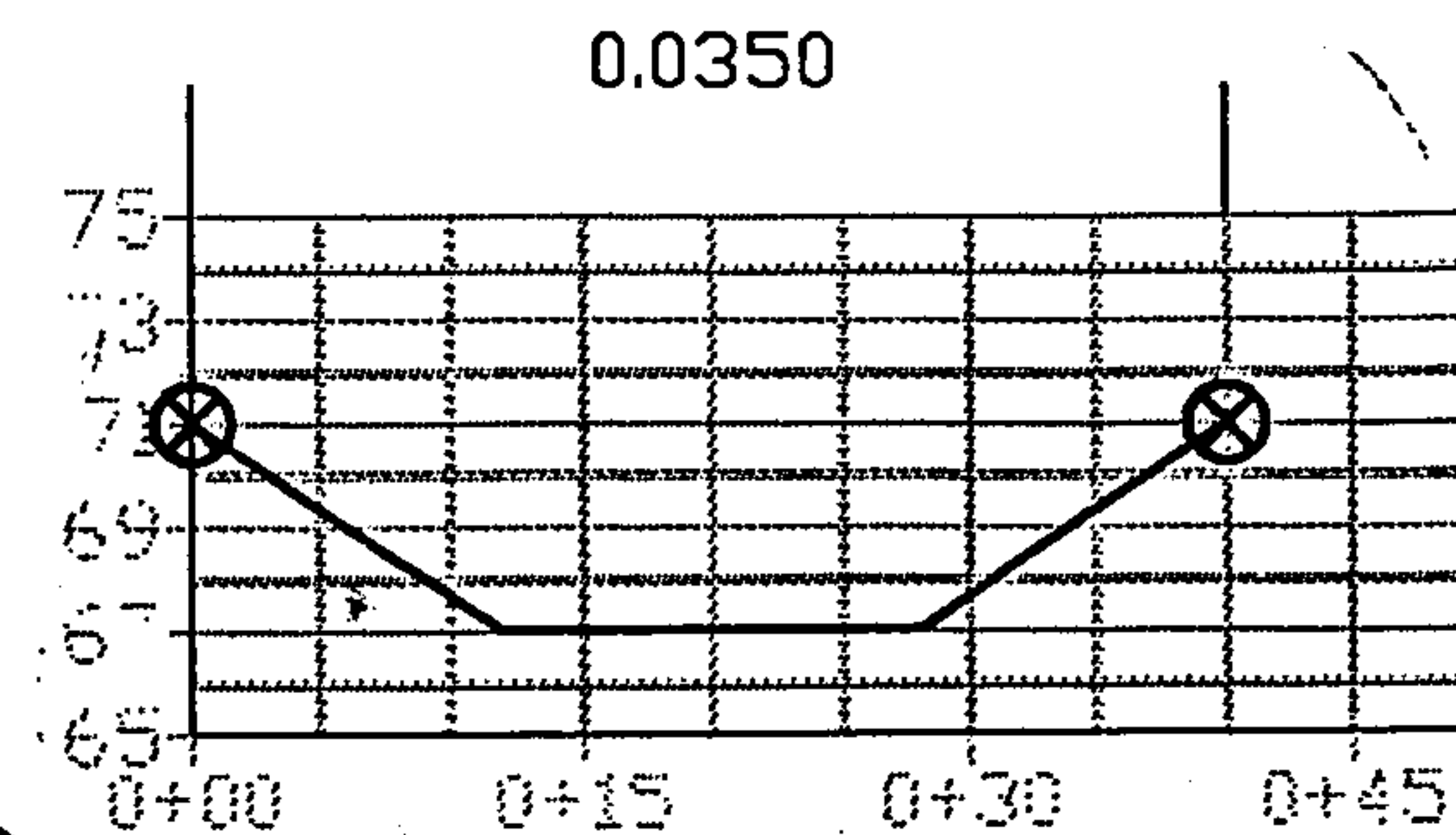
2249
224.9' END DIRT @ SOIL CEMENT



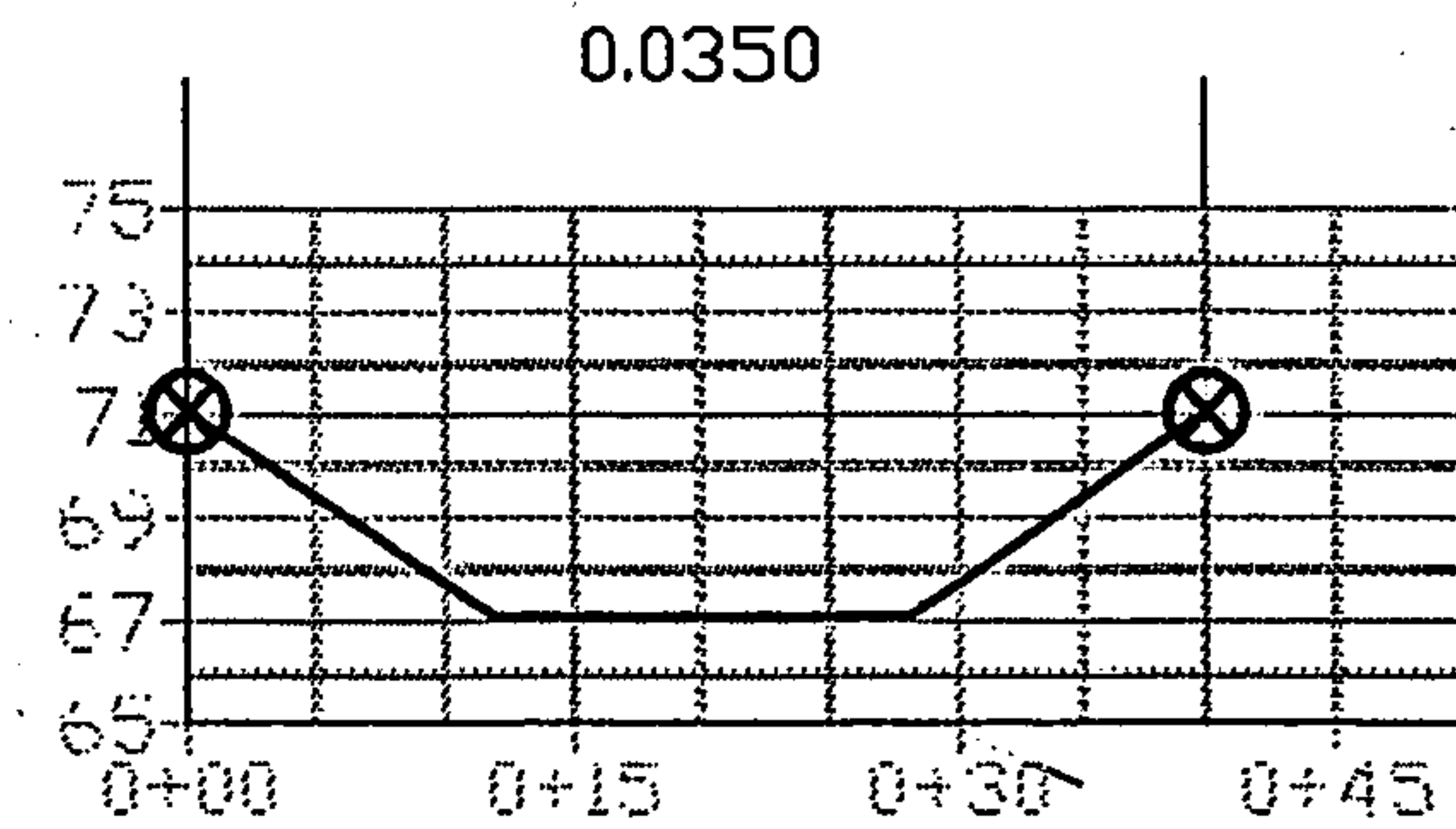
2250
DWN END SOIL CEMENT APRON



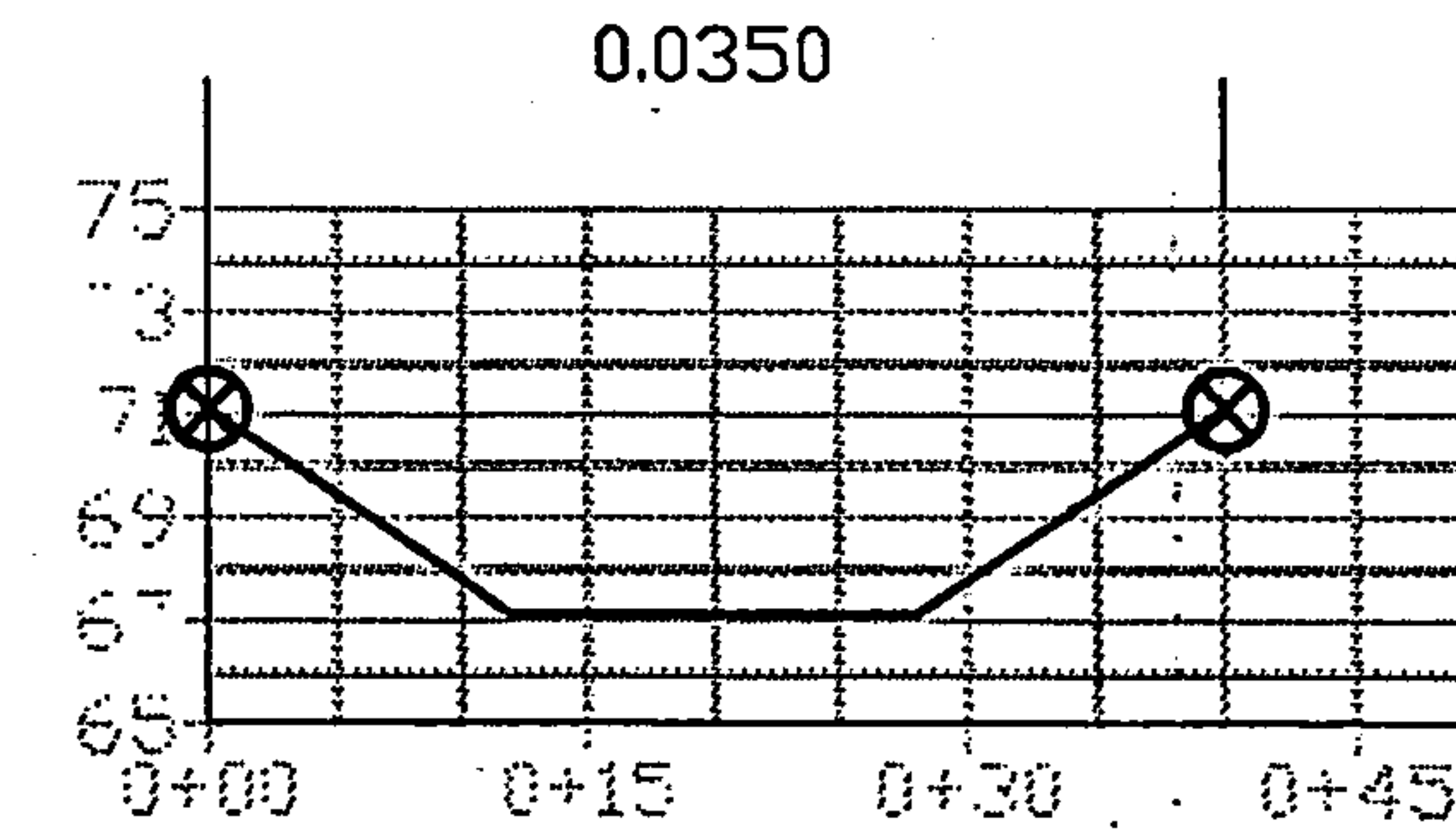
2450
DWNSTR FACE OF CULVERT



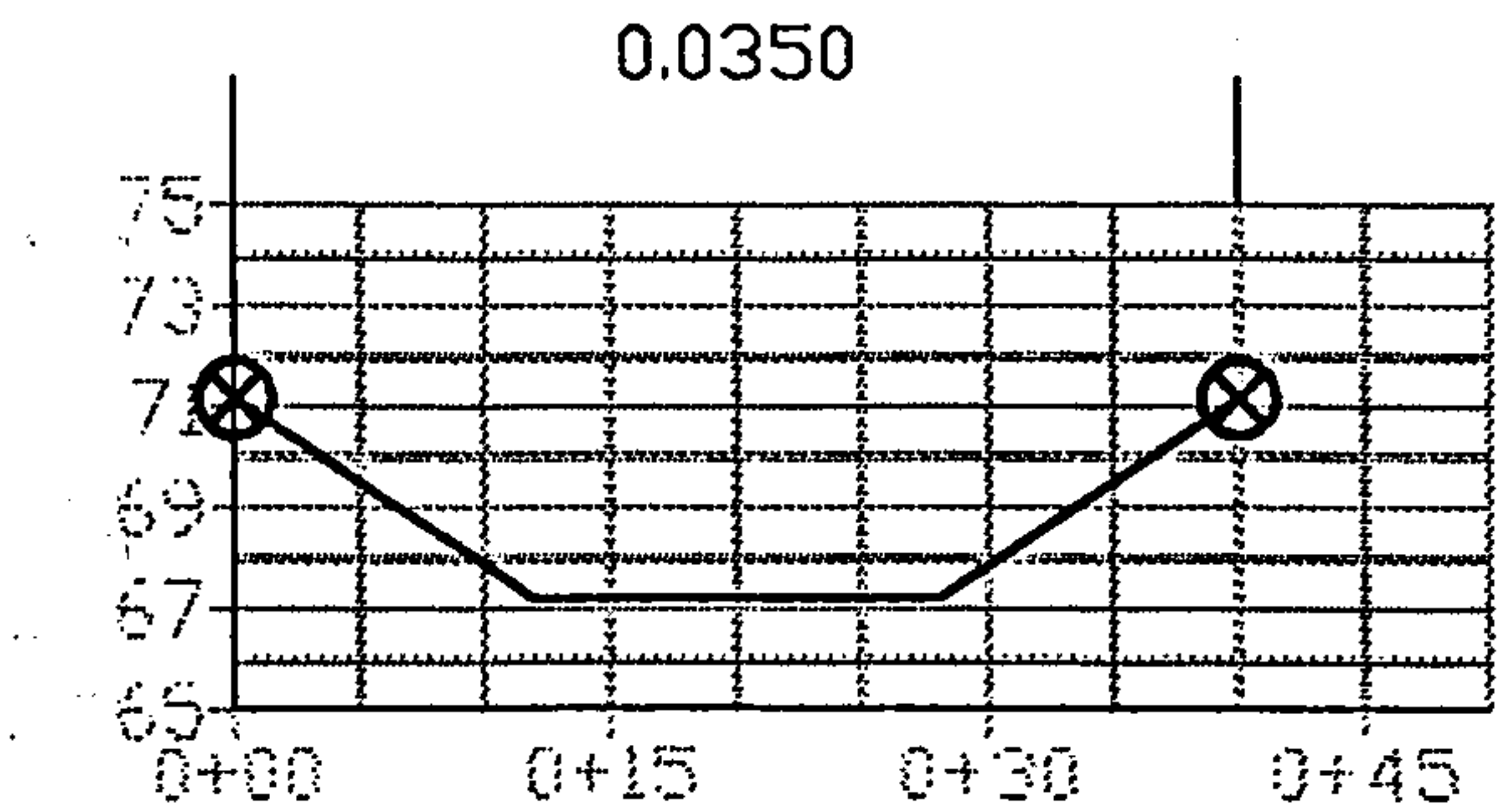
1
1000
DUMMY START STATION, AKA B4
100' DWN FROM TIE TO EX BANKS.
STA'S 125 - 175 ALSO DUMMIES



1250
DUMMY EXIST, AKA B3



1500
DUMMY EXIST

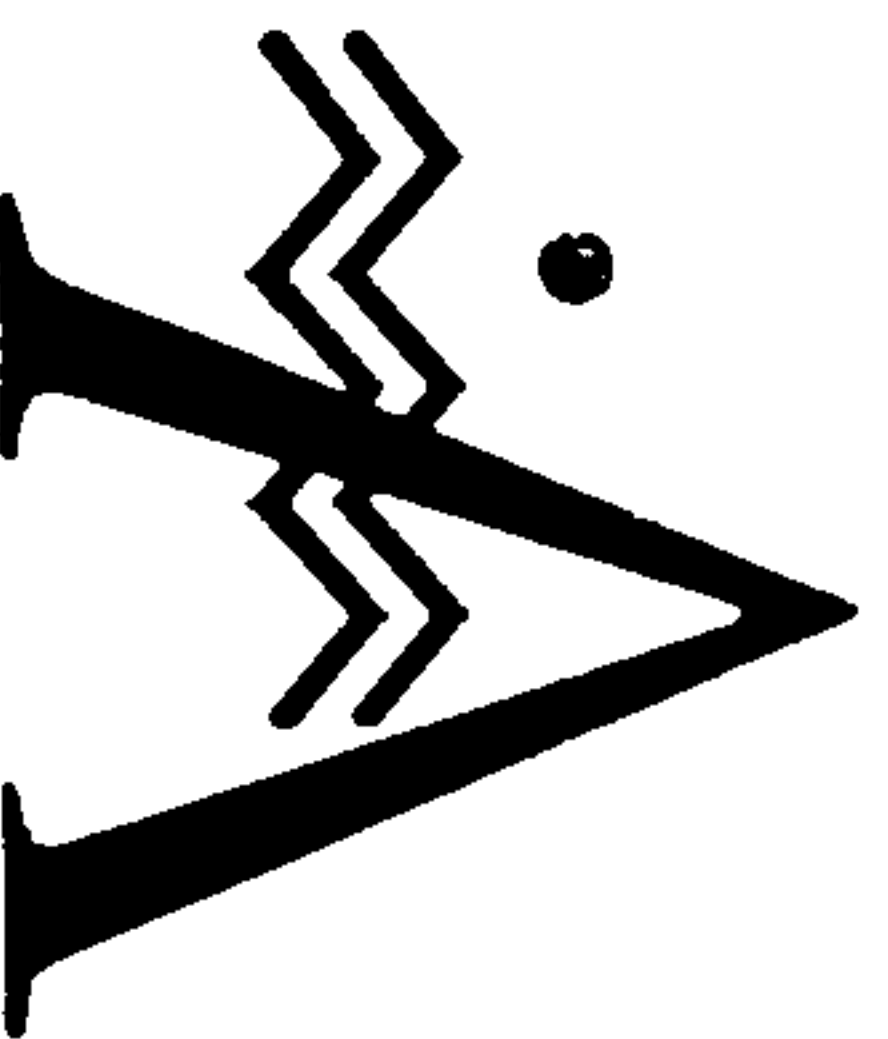


1750
DUMMY EXIST

HEC-2 CROSS-SECTIONS

RON JOHNSON BOX CULVERTS AT 4 HILLS DIVERSION CHANNEL
DWG: C:\ACAD\AH2\RONJH2A DATE: 06/26/97 TIME: 09:47 T. GREEN

FIGURE 2



CITY OF
Albuquerque

Public Works Department

May 28, 1997

Martin J. Chávez, Mayor

Robert E. Gurulé, Director

Bob Ryals

Ryals Engineering & Construction Service Co.

5301 Central Avenue NE Suite #913

Albuquerque New Mexico 87108

RE: Drainage Report for Ron Johnson Access Road (M23-D13) Received April 29 1997

Dear Mr Ryals:

I have reviewed the referenced plan dated April 25, 1997 and forward the following comments.

1. Please follow the DPM in reference to Berms and Levees on page 91. The items of concern are cross section, certification, freeboard, and bank protection. The proposed berm length that would be improved would be the berm length that would have to follow the DPM criteria.
2. By placing the culverts in the berm diversion channel you have reduced the cross sectional area of flow. This existing cross sectional area must be maintained with the new improvements. The minimum capacity would be the 100 year flow. This minimum flow must include any extension of the levee to the north which would increase the 100 year flow.
3. Please address the 100 year discharge that would flow west on the new proposed road. Submit the proposed subdivision that would drain to the proposed road. The type of road section will determine the possible carrying capacity of the road. A storm drain may need to be designed. The proposed subdivision must show the 100 year outfalls.
4. Please design La Cabra Drive east of Four Hills Diversion Ditch. Show the 100 year flows from the new subdivision.
5. How will the flows from the proposed road be introduced into the Four Hills Diversion Channel.

Good for You, Albuquerque!

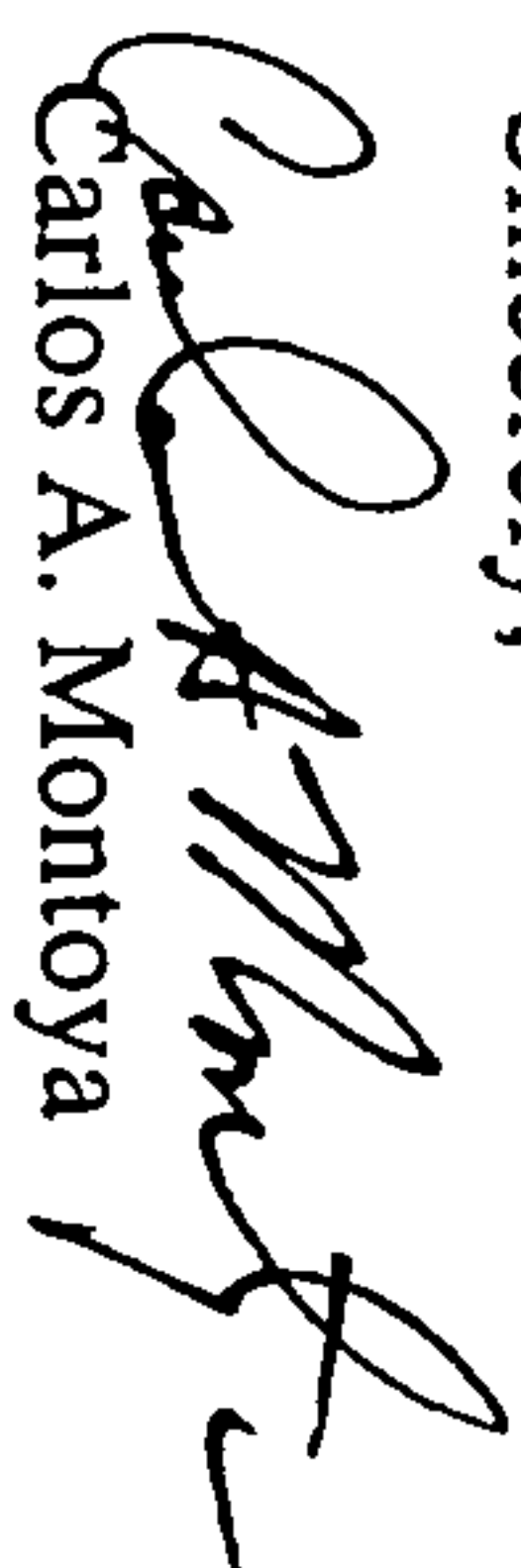
P.O. Box 1293, Albuquerque, New Mexico 87103



6. Depending on the flows from the new subdivision and access road the Four Hills Diversion Ditch may have to be improved.

If you have any questions please call me at 924-3984.

Sincerely,


Carlos A. Montoya
Project Manager

c: Andrew Garcia
File

DRAINAGE INFORMATION SHEET

PROJECT TITLE: Pen Johnson Access Road Zone Atlas/DRNG. FILE #: M23-D13

DRB #: _____ EPC #: _____ WORK ORDER #: _____

LEGAL DESCRIPTION: Pen Johnson Access, 11th INSTALMENT, PLOTS OF

CITY ADDRESS: STAGE COACH & LA CARRA RANOS P.O. BOX

ENGINEERING FIRM: RYANS ENGINEERING CONTACT: Robert Ryans

ADDRESS: 5301 CENTRAL AVE #913 PHONE: 256-4701

OWNER: Pen Johnson 87108 CONTACT: Pen Johnson

ADDRESS: 1124 Mount Lago NE PHONE: 291-8742

ARCHITECT: _____ CONTACT: _____

ADDRESS: _____ PHONE: _____

SURVEYOR: _____ CONTACT: _____

ADDRESS: _____ PHONE: _____

CONTRACTOR: _____ CONTACT: _____

ADDRESS: _____ PHONE: _____

TYPE OF SUBMITTAL:

☒ DRAINAGE REPORT

☐ DRAINAGE PLAN

☐ CONCEPTUAL GRADING & DRAINAGE PLAN

☐ GRADING PLAN

☐ EROSION CONTROL PLAN

☐ ENGINEER'S CERTIFICATION

☒ OTHER CULVERT DESIGN
ROAD CONSTRUCTION

PRE-DESIGN MEETING:

☐ YES

☐ NO

☐ COPY PROVIDED

CHECK TYPE OF APPROVAL SOUGHT:

☐ SKETCH PLAT APPROVAL

☐ PRELIMINARY PLAT APPROVAL

☐ S. DEV. PLAN FOR SUB'D. APPROVAL

☐ S. DEV. PLAN FOR BLDG. PERMIT APPROVAL

☐ SECTOR PLAN APPROVAL

☐ FINAL PLAT APPROVAL

☐ FOUNDATION PERMIT APPROVAL

☐ BUILDING PERMIT APPROVAL

☐ CERTIFICATE OF OCCUPANCY APPROVAL

☒ GRADING PERMIT APPROVAL

☒ PAVING PERMIT APPROVAL

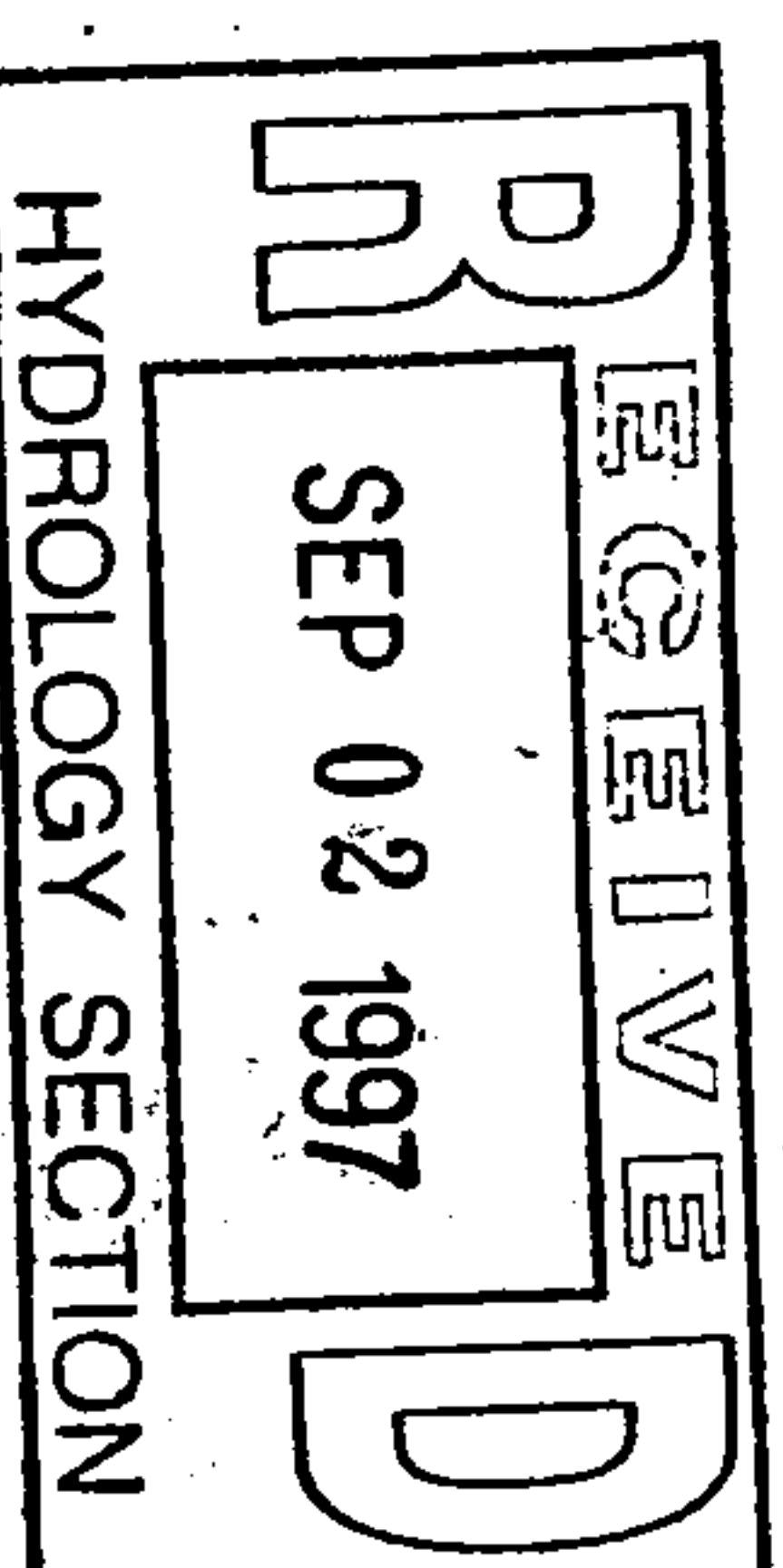
☐ S.A.D. DRAINAGE REPORT

☒ DRAINAGE REQUIREMENTS

☐ OTHER _____ (SPECIFY)

DATE SUBMITTED: 9-2-97

BY: RYANS ENGINEERING



HYDROLOGY SECTION

RYALS

engineering & construction services

5301 Central Ave. NE * Suite 913 * Albuquerque, New Mexico 87108

Phone (505) 256-4701

Fax (505) 266-6448

September 2, 1997

Exhibit 4 - see comments

Mr. Carlos Montoya
Project Manager
Hydrology Section
Public Works Department
City of Albuquerque
P.O. Box 1293
Albuquerque, N.M. 87102

RE: DRAINAGE REPORT FOR RON JOHNSON ACCESS ROAD-CP #5357.90,
Map M-23/D13-RESPONSE TO COMMENTS ON REPORT DATED APRIL 25, 1997.

Dear Mr. Montoya:

1. DPM criteria for berm design is not applicable to this revised plan. Culverts have been resized to maintain normal flow depth below top of existing berm.
2. The revised plan increases the culvert capacity to carry the 100 year flow without increasing depth of flow upstream or downstream of the proposed crossing structure. The contributing water shed is presently not developed. Due to topography and zoning very little development is anticipated. Therefore an increase in runoff due to development is not expected.
- 3a. The revised plans include rundowns to drain roadway runoff, developed east of the drainage structure, into the channel. The roadway runoff entering Four Hills would be that developed on the 160 feet of paving west of these rundowns. This flow is a negligible increase to the 100 year volume and peak rate of flow of the existing drainage basin.
- 3b. The proposed paving would increase the Four Hills Diversion Channel flow about 4.5 cfs, a nominal increase.
- 3c. The subdivision which the proposed road will serve has not been designed. Flow from any future subdivision design, including the flows from this roadway, must be such that downstream capacity of the Four Hills Diversion Channel will not be exceeded. If ponding to control discharge from the future subdivision is required, it will be incorporated into the drainage and grading plans at that time.
4. The La Cebra right-of-way has been vacated, and no future development of that road is anticipated.

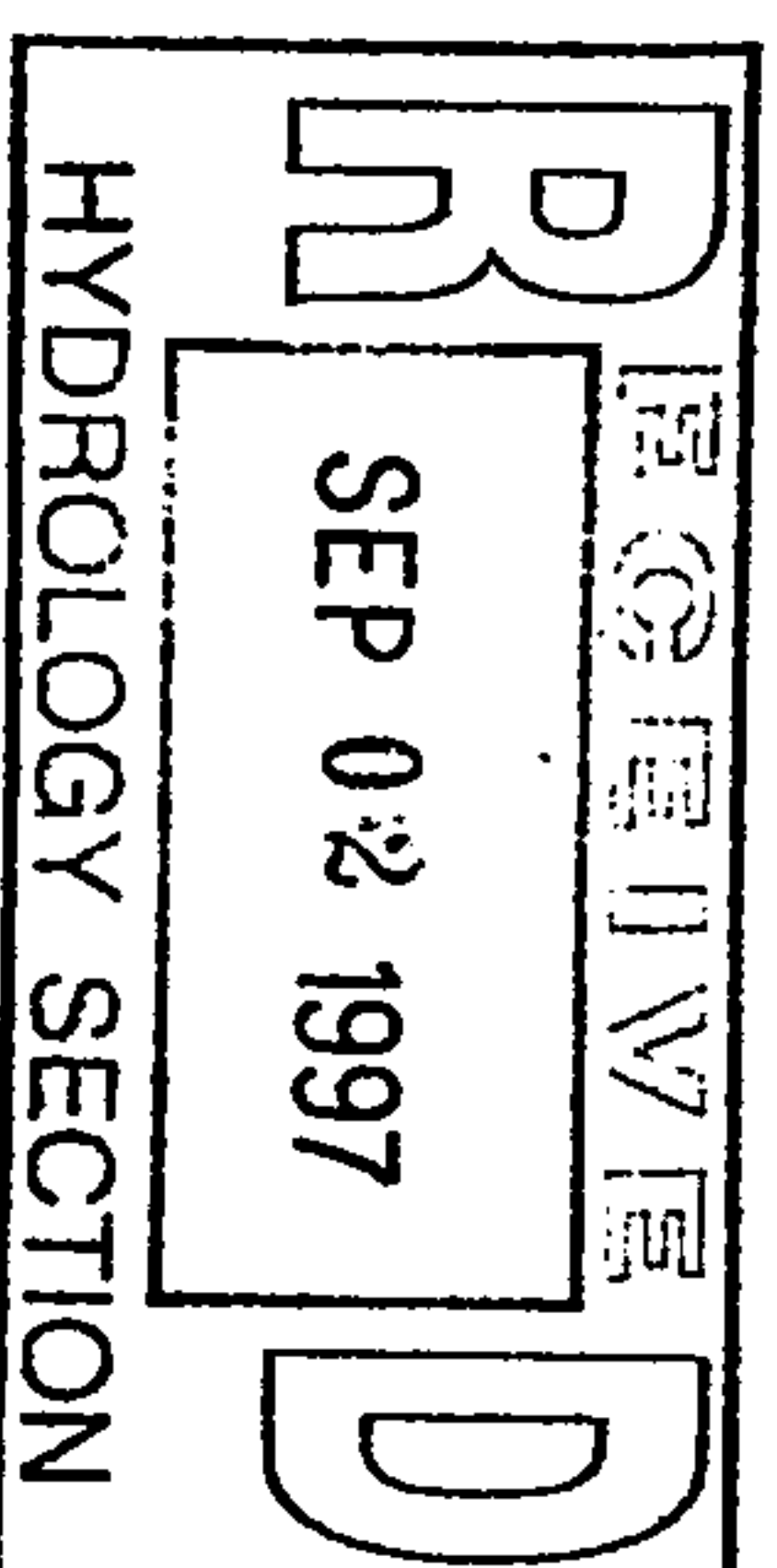
5. The flows from the proposed road will be introduced into the Four Hills Diversion Channel by run downs as shown on the revised plans.
6. Based on revised report and the discussion above, no improvement of the Four Hills Diversion Channel is required.

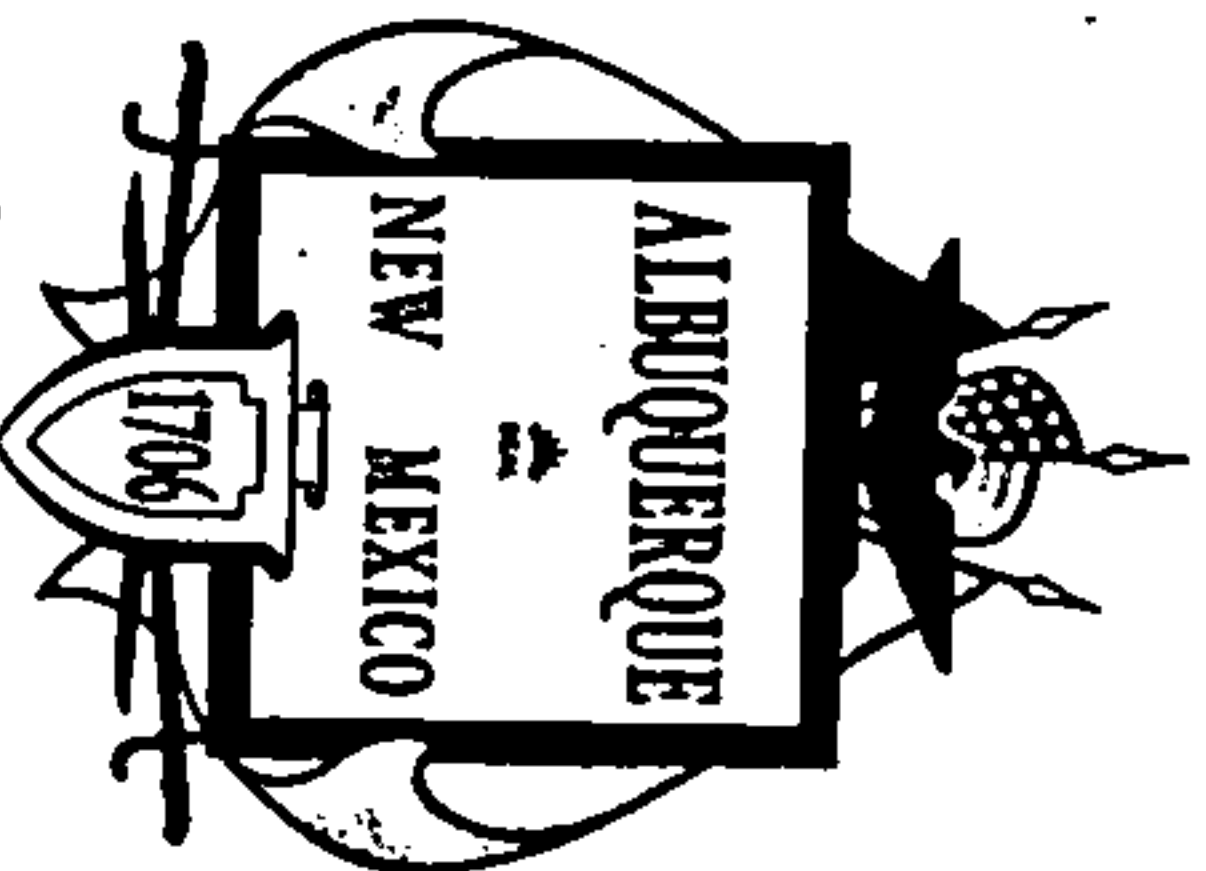
Sincerely,



Robert B. Ryals, P.E.

cc: John Castillo-Asst. Public Works Director
Billy Goolsby-DRC Chairman
Kevin Broderick-Transportation Engineer
John Stomp-Water, Master Water Engineer





City of Albuquerque

P.O. BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

February 1, 1996

Bob Ryals
Ryals Engineering and Construction
5301 Central Ave NE
Suite 913
Albuquerque, NM 87108

RE: RON JOHNSON ACCESS ROAD (M23-D13) DRAINAGE REPORT FOR GRADING
PERMIT & WORK ORDER APPROVAL. ENGINEER'S STAMP DATED 1-24-96.

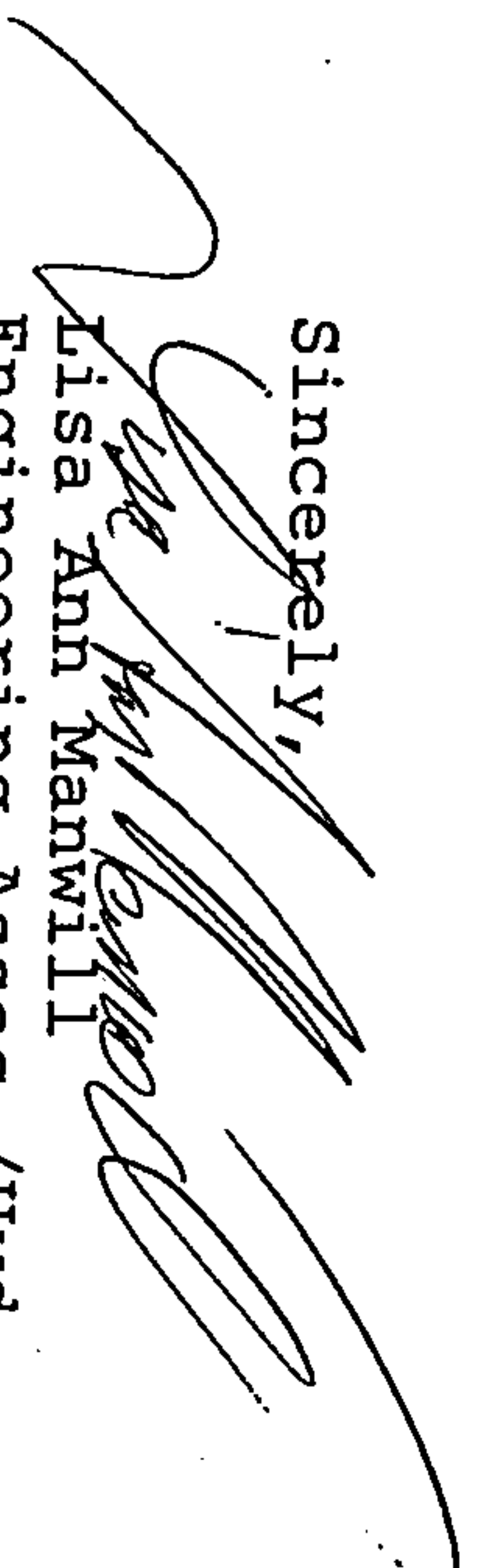
Dear Mr. Ryals:

Based on the information provided on your January 25, 1996
submittal, City Hydrology has the following comments:

1. CMP is not allowed in City right-of-way. You need to use RCP
for the culverts.
2. The portion of the proposed roadway that runs through City
right-of-way will require a paved, all weather crossing, built
to City standards.
3. How will you deal with the increased velocity at the culvert?
Do you plan on constructing head walls, or some other control
structure at the culverts?
4. Please keep in mind that if the property owner wants to
develop or subdivide his property, the entire roadway will
need to be paved. The City Drainage Ordinance requires at
least one paved access.
5. The copy of the plat you sent to me is not the most recent.
Please submit the most up to date copy of the plat. I am
particularly interested in the drainage easement for the
diversion channel.

If I can be of further assistance, please feel free to contact me
at 768-3622.

Sincerely,


Lisa Ann Manwill
Engineering Assoc./Hyd.

c: Andrew Garcia

 File

SECOND JUDICIAL DISTRICT COURT
COUNTY OF BERNALILLO
STATE OF NEW MEXICO

No. CV 88-04585

PATRICK J. MURPHY and
MARILYN MURPHY, his wife,
and BOB TINLEY,

Plaintiffs,

vs.

CITY OF ALBUQUERQUE,

Defendant.

STIPULATED SETTLEMENT

The parties to the above numbered and entitled cause, Plaintiffs Patrick J. Murphy and Marilyn Murphy, his wife, and Bob Tinley, and Defendant City of Albuquerque hereby agree and stipulate as follows:

1. Patrick J. Murphy and Marilyn Murphy, his wife, ("Murphy"), are the owners of real property located in Bernalillo County, New Mexico (the "Murphy Tract"), more particularly described as follows:

The SW 1/4 SW 1/4, of Section 36, T 10 N, R 4 E, of the New Mexico Principal Meridian, Bernalillo County, New Mexico.

2. Langdon Harrison, Patricia Eichenberg, and James H. Foley and Martha Foley, his wife, (collectively referred to as the "Harrison Group") are owners of real property located in Bernalillo County, New Mexico (the "Tinley Tract"), more particularly described as follows:

The NW 1/4 SW 1/4, Section 36, T 10 N, R 4 E., New Mexico Principal Meridian, Bernalillo County, New Mexico.

3. Bob Tinley ("Tinley") is the assignee of the Harrison Group with respect to the claims set forth in Counts I, II, III, IV, V and VI of the Complaint in this cause.

4. The City of Albuquerque ("City") is owner of certain real property (the "City Open Space") located in Bernalillo County, New Mexico, and more particularly described in Paragraph 4 of Plaintiff's Complaint.

5. The City is also owner of certain other real property (the "Tank Property") located in Bernalillo County, New Mexico, and more particularly described in Paragraph 5 of Plaintiff's Complaint.

6. By the Plat of Four Hills Village, Eleventh Installment, filed January 14, 1972 in Vol. D-4, Folio 181 of the records of Bernalillo County, New Mexico, and the City's acceptance of the dedications shown thereon, Stagecoach Road SE and La Cabra Drive SE were dedicated to the use of the public forever as public streets.

7. The City replatted a portion of said Eleventh Installment by the City of Albuquerque's Replat of Portions of Tract "A" and Tract "A-1" of the Lands of Four Hills Village and a portion of the Eleventh Installment of Four Hills Village, recorded June 11, 1984 in Vol. C-24, Folio 52, of the records of Bernalillo County, New Mexico, and pursuant to said Replat, Stagecoach Road SE and La Cabra Drive SE were not vacated and remained dedicated to the use of the public forever.

8. That portion of Stagecoach Road SE located on the City Open Space, and that portion of La Cabra Drive located on the City Open Space between its intersection with Stagecoach Road and La Cabra Drive's termination at the west boundary of the Murphy Tract (the "Dedicated Access") remains and shall remain a dedicated public road, which is open to the use of the public. The Dedicated Access is shown in yellow on the map attached hereto as Exhibit 1. The portions of Stagecoach and LaCabra shown in green on Exhibit 1 may be vacated and are not claimed by the Plaintiffs.

9. The City shall be allowed to leave the existing barricades in place at the west end of the Dedicated Access until such time as construction of a drainage structure and road across the berm (the Four Hills Diversion Channel) to a point at which the Dedicated Access reaches original natural grade is begun by Tinley and is appropriately secured for public safety. "Appropriate" here means as approved by the City Traffic Operations Engineer. At such time as the above construction begins, the existing barricades shall be removed and replaced with construction barricades. Until such time as the existing barricades are removed, the existing barricades shall be secured by a duplex lock system, that is, one lock which shall be accessible to the City, connected to another lock which shall be accessible to Tinley and his invitees. The City shall, within ten days of the date of this stipulated Settlement, provide and construct a chain or other systems sufficient to accommodate the duplex lock system.

10. The City shall not vacate the Dedicated Access and shall oppose any attempted vacation of the Dedicated Access by any individual entity, private or other group.

11. Murphy and/or Tinley shall not agree to the extension of public or private access to any property outside the boundaries of the Tinley and/or Murphy Tracts. However, notwithstanding the foregoing, Murphy and/or Tinley shall be allowed to extend access to and outside the boundaries of their respective tracts if in connection with the approval of a development plan for the Tinley and/or Murphy Tracts, the City (or an agency, board, commission or department thereof or any person or entity having such authority) requires, i.e., as a mandatory condition to City approval of the plan, that access be extended or provided to the boundaries of the Tinley and/or Murphy Tracts. Provided, however, that a recommendation by the City to another governmental body (such as Bernalillo County) regarding access in which the City is acting purely in an advisory capacity using county standards for development, shall not be deemed to be a requirement by the City regarding access. Further, notwithstanding the first sentence of the paragraph, Murphy and/or Tinley shall not be in violation of this agreement regarding road extension if required to do so by any final order of any Court or administrative board of competent jurisdiction. Moreover, the parties hereto specifically recognize that Murphy and Tinley have an agreement to extend roads for ingress and egress between the Murphy and Tinley tracts and thereby providing the Tinley tract as well as the Murphy tract with access

to La Cabra Drive and/or Stagecoach Road SE and nothing in this paragraph is intended to interfere with or modify that agreement and the City agrees that the agreement is not in violation of any terms hereof.

12. The City owns a water tank (the "Tank") located on the Tank Property, for which there is a discharge pipe which, from time to time, discharges water onto the Tinley property creating an arroyo running east from the water tank and located on the Tinley Tract. With regard thereto, except in an emergency the City shall immediately cease discharge therefrom from the date of this Stipulated Settlement forward and shall then undertake and complete one of the following options within eight months of the date of this Stipulated Settlement.

A. The City shall redirect the flow of water from the discharge pipe so that no water is capable of being discharged and/or discharged onto the Tinley and/or Murphy Tracts, and shall fill the arroyo east of the Tank to the existing grade up to a point at which the arroyo turns in a northerly direction or intersects with an arroyo running in a northerly direction. The City shall not hereafter cause or allow the discharge of any water from the Tank onto the Tinley Tract; or

B. The City may request and in such event Tinley shall grant the City an Easement upon the following terms and conditions:

1. The Easement shall be approximately 40 feet wide from the point of discharge at the West line of the Tinley Tract, running along the arroyo in an

easterly direction approximately 400 feet to the point at which the arroyo turns North or joins another arroyo running north. From this intersection or angle point the easement shall be approximately 50 feet wide and run northerly approximately 350 feet, at which point the easement shall increase to approximately 60 feet wide and continue northerly approximately 100 feet to the North boundary of the Tinley Tract. The City shall at its own expense survey, monument and mark the boundaries of the easement and provide within three months easement description and easement agreement.

2. For agreed upon damages, the City shall pay Tinley \$10,125.00.

3. The Easement shall be for drainage from the Water Tank and maintenance of provided that the Easement Agreement shall specifically provide that the flow in the Easement shall not be restricted in such a manner as to cause the discharge to be retained and further provided that Tinley may use the property and arroyo within the easement for site drainage in any development plan for the Property.

4. The City shall within eight months of the date of this Stipulated Settlement design and install within the easement and as close to the center of the easement as possible a culvert or drainage pipe

of a sufficient capacity to handle the periodic and/or emergency discharges from the Tank and the natural drainage from the tank area, from the present point of discharge to a point 60 feet east of the west property line of the Tinley tract. The City shall further cover the installed pipe with compacted fill to the existing natural grade. The City shall engineer the discharge at the termination of the culvert or drainage pipe to minimize further damage, i.e., the engineering shall be at least to the specification that the City would require of a private developer. In the event the option under this paragraph 12B is selected then the City shall indemnify, defend and hold and save harmless Tinley and/or Murphy from claims of third parties attributable to the water flow. The Culvert or Drainage pipe and compacted fill shall be installed at engineering specifications and standards which would be acceptable to the City if the installation were being performed by or for a private entity or developer for the purpose of placing a paved roadway over and across the compacted fill.

13. The fence or other barrier as required by the City (or any board, agency, commission, department or other body thereof) shall be constructed along both sides of the Dedicated Access, adjoining the Open Space by the City, at its own expense within three months of the date of this stipulated settlement.

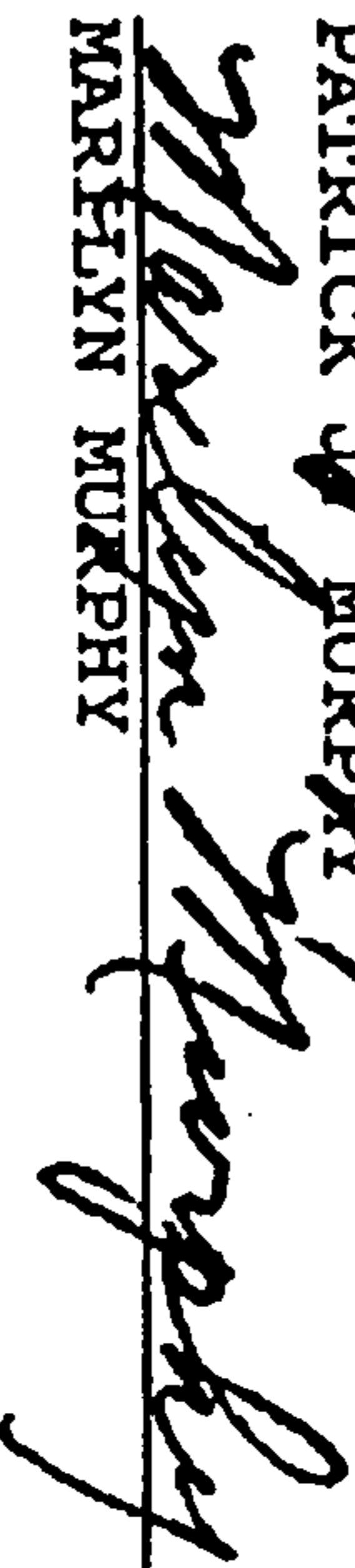
14. The City shall pay to Tinley as additional liquidated damages the sum of \$23,000.00.

15. This Agreement shall inure to the benefit of and be binding upon the parties hereto, their predecessors, heirs, devisees, personal representatives, assigns and successors in interest.

16. Each of the parties shall bear their own respective costs and attorneys fees incurred in this litigation.

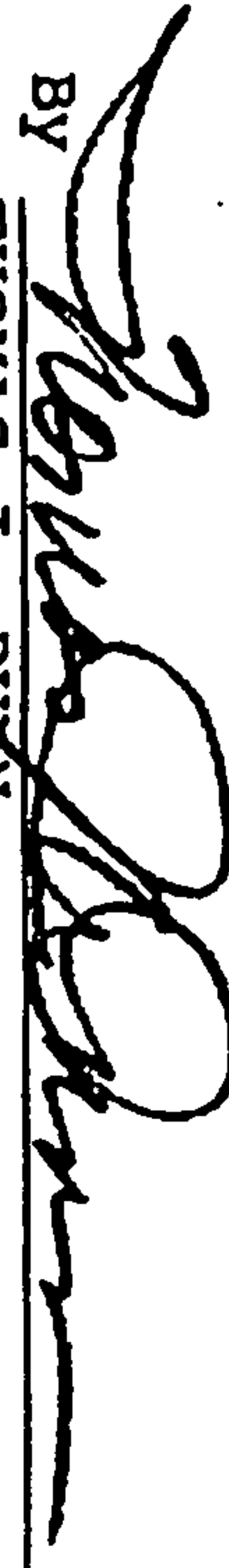
EXECUTED this 1st day of December, 1989.


PATRICK J. MURPHY


MARILYN MURPHY


BOB TINLEY

MOSES, DUNN, BECKLEY,
ESPINOSA & TUTHILL, P.C.


BY THOMAS J. DUNN

STEVEN J. HILE
Attorneys for Plaintiffs
612 First Street, N.W.
P. O. Box 27047
Albuquerque, NM 87125-7047
(505) 843-9440

CITY OF ALBUQUERQUE

BY
Its


Asst City Attorney

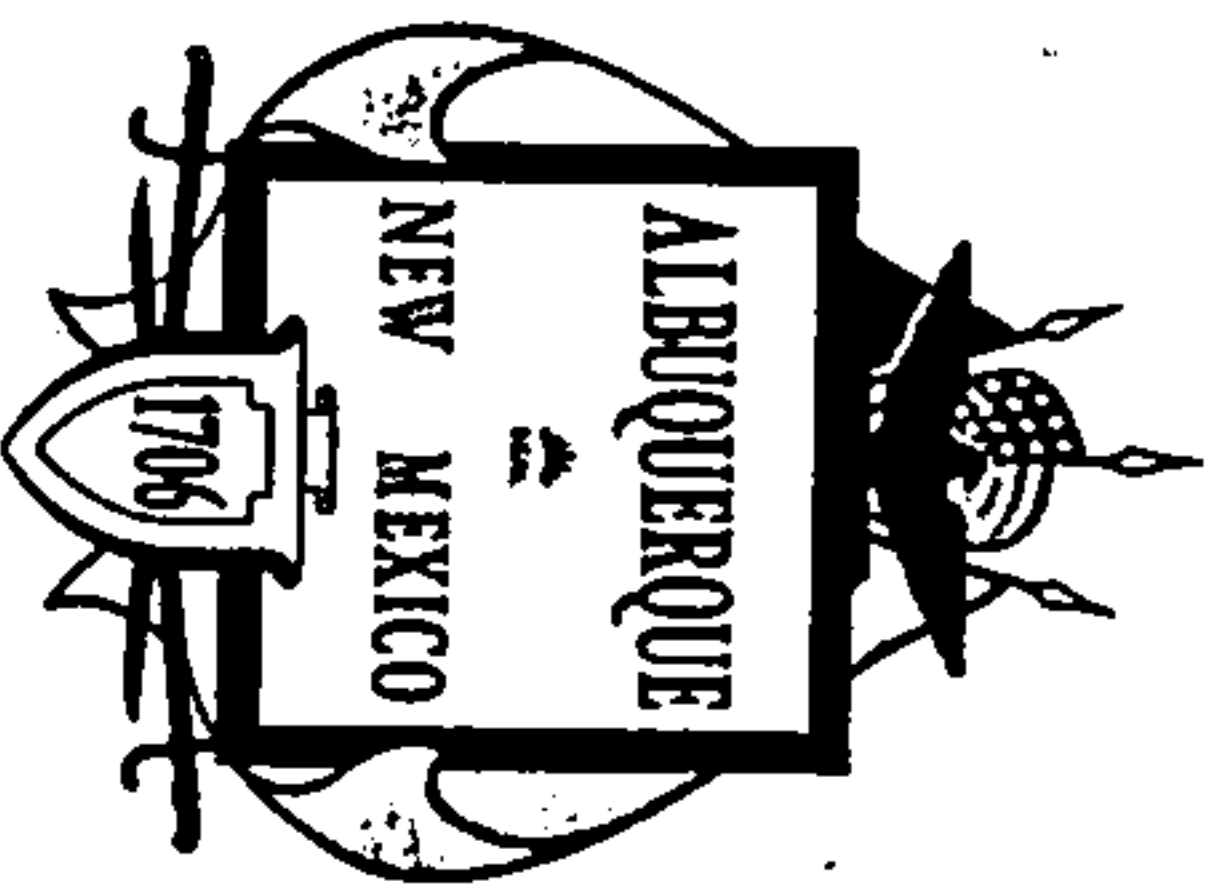
FRANKLIN, ABERNETHY & HUGHES, P.C.

BY


ERIC R. HALL

Attorneys for Defendant
215 Central Avenue N.W.
P. O. Box 1610
Albuquerque, NM 87103

PARCELS A,B,C & D
CITY OF ALBUQUERQUE'S REPEAT OF
PORTIONS OF TRACT "A" and TRACT "A"-1
OF THE LANDS OF FOUR HILLS VILLAGE
AND A PORTION OF THE 11th INSTALLMENT
OF FOUR HILLS VILLAGE
WITHIN SECTION 35, T10N, R4E, N14M, ALBUQUERQUE, NEW MEXICO
APRIL, 1984



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

January 17, 1996

Bob Ryals
Ryals Engineering and Construction
5301 Central Ave NE
Suite 913
Albuquerque, NM 87108

RE: RON JOHNSON ACCESS ROAD (M23-D13) DRAINAGE REPORT SUBMITTAL
FOR GRADING PERMIT AND WORK ORDER APPROVAL. ENGINEER'S
STAMP DATED JANUARY 5, 1996.

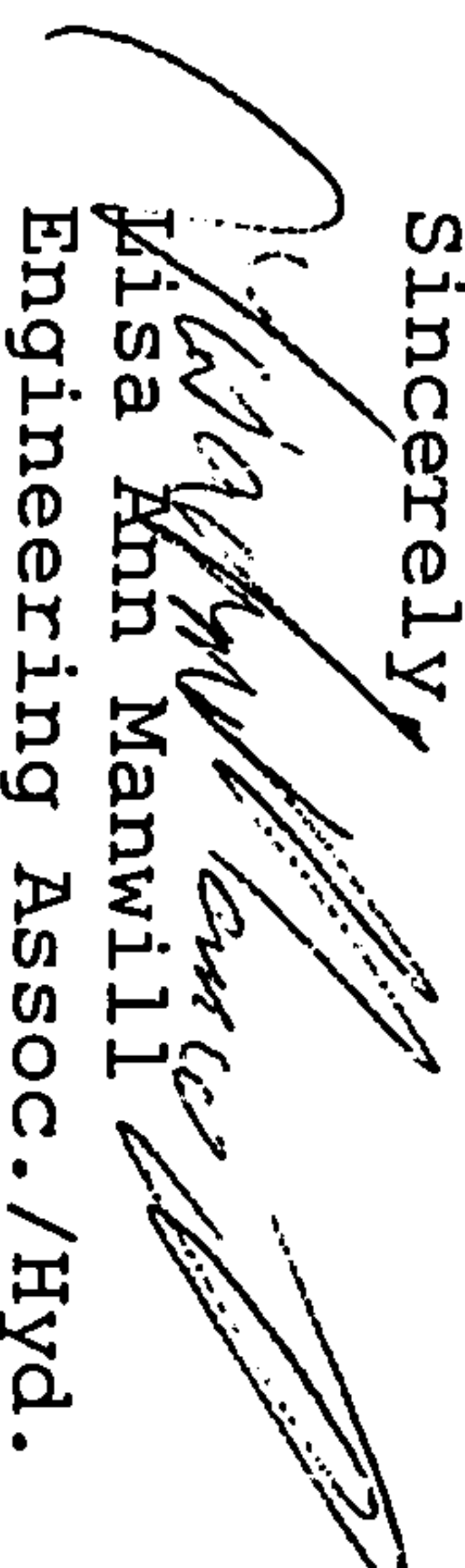
Dear Mr. Ryals:

Based on the information provided on your January 9, 1996
submittal, City Hydrology has the following comments:

1. Your plan shows two 54 inch diameter CMP across the road and
your drainage report recommends the use of four 54 inch
diameter CMP. This statement was found on the last page of
text under the heading **RECOMMENDATIONS**. Please update the
plan sheet.
2. Is this a gravel road?
3. Please provide a copy of the plat.
4. Please give invert elevations for each culvert.
5. Please provide a note on the plan sheet stating the minimum
depth of cover over the CMP.

If I can be of further assistance, please feel free to contact me
at 768-3622.

Sincerely,


Lisa Ann Manwill
Engineering Assoc./Hyd.

c: Andrew Garcia
 File

F. BERMS AND LEVEES

All levees and berms constructed for drainage or flood control purposes and which are required to contain or convey 50 cfs or more in the event of the 100 year design discharge must conform to the following guidelines:

1. Cross Section

- a. Unarmored faces of berms and levees must have side slopes not steeper than 3:1 (horizontal to vertical).
- b. Rock rip rapped faces of berms and levees must have side slopes not steeper than 2:1 (horizontal to vertical)
- c. Concrete faced berms and levees may have side slopes of 2:1 (horizontal to vertical)
- d. Berms and levees less than 4 feet in height must have a minimum top width of 8.0 feet.
- e. Berms and levees 4.0 feet high and greater must have a minimum top width of 12 feet.
- f. All berms and levees must be provided with a structural keyway with bottom width equal to the top width and depth equal to at least one half the height, but not less than 3.0 feet and side slopes not steeper than 2:1 (horizontal to vertical)

2. Certification

All levees and berms with heights greater than 5.0 feet shall be inspected during construction and certified by a New Mexico Professional Engineer as to their substantial compliance to the plans and specifications. Certified as-built drawings, accompanied by daily inspection reports, shall also be provided.

- 3: Any berm or levee whose purpose is to divert or convey runoff in a major arroyo shall be specially designed on a case by case basis and shall meet or exceed the guidelines listed herein.

4. Freeboard

Berms and levees must be provided with freeboard for the 100-year design flow based on the following guidelines:

- a. For flow depths less than 3.0 feet and not involving a major arroyo; minimum freeboard is 2.0 feet.
- b. For flow depths 3.0 feet and greater and involving a major arroyo; minimum freeboard is 3.0 feet.

5. Bank Protection

All berms and levees expected to convey or divert 50 cfs or more in the event of the 100-year design discharge must be provided with bank protection according to the following guidelines:

- a. Bank protection must be provided wherever design velocities exceed 8 feet/sec.
- b. Bank protection must be provided on the outside of curves from the beginning of curvature, through the curve and for a distance equal to 5 times the flow velocity in feet downstream from the point of tangency.
- c. When required, bank protection must be provided to two feet above the design flow depth plus additional depth as required (e.g. superlevation, waves at confluences, hydraulic jumps, etc.).
- d. Bank protection must extend downward on a projection of the bank slope, to a minimum depth equal to 1.5 times the design flow depth but never less than 3.0 feet. Bank protection for major arroyos shall be accompanied by a City Engineer approved sediment transport analysis.

NOTE: BERMS, DAMS, LEVEES, AND DIVERSIONS OF CERTAIN MAGNITUDES AND NATURE MAY FALL WITHIN THE JURISDICTION OF THE STATE ENGINEER OF THE STATE OF NEW MEXICO. THE DESIGN PROFESSIONAL IS EXPECTED TO BE AWARE OF AND COMPLY WITH REGULATIONS PROMULGATED BY THAT JURISDICTION.

14231013

PROJECT TITLE: Ron Johnson Access Road ZONE ATLAS/DRNG. FILE #: ~~24-23-2~~

DRB #: _____ EPC #: _____ WORK ORDER #: _____

LEGAL DESCRIPTION: Parcel A, Tract A, Lands of Four Hills Village, 11th Install

CITY ADDRESS: Intersection of Stagecoach and La Cebra S. E

ENGINEERING FIRM: Ryals Eng & Const. Serv. Co. CONTACT: Robert B. Ryals

ADDRESS: 5301 Central Avenue N. E. #913 PHONE: 256-4701

OWNER: Ron Johnson CONTACT: _____

ADDRESS: 1124 Monte Largo N. E. PHONE: 291-8742

ARCHITECT: _____ CONTACT: _____

ADDRESS: _____ PHONE: _____

SURVEYOR: _____ CONTACT: _____

ADDRESS: _____ PHONE: _____

CONTRACTOR: _____ CONTACT: _____

ADDRESS: _____ PHONE: _____

TYPE OF SUBMITTAL:

☒ DRAINAGE REPORT

☐ DRAINAGE PLAN

☐ CONCEPTUAL GRADING & DRAINAGE PLAN

☒ GRADING PLAN

☐ EROSION CONTROL PLAN

☐ ENGINEER'S CERTIFICATION

☐ OTHER

CHECK TYPE OF APPROVAL SOUGHT:

☐ SKETCH PLAT APPROVAL

☐ PRELIMINARY PLAT APPROVAL

☐ S. DEV. PLAN FOR SUB'D. APPROVAL

☐ S. DEV. PLAN FOR BLDG. PERMIT APPROVAL

☐ SECTOR PLAN APPROVAL

☒ FINAL PLAT APPROVAL

☐ FOUNDATION PERMIT APPROVAL

☐ BUILDING PERMIT APPROVAL

☐ CERTIFICATE OF OCCUPANCY APPROVAL

☒ GRADING PERMIT APPROVAL

☐ PAVING PERMIT APPROVAL

☐ S.A.D. DRAINAGE REPORT

☐ DRAINAGE REQUIREMENTS

☒ OTHER work on DEN (SPECIFY)

PRE-DESIGN MEETING:

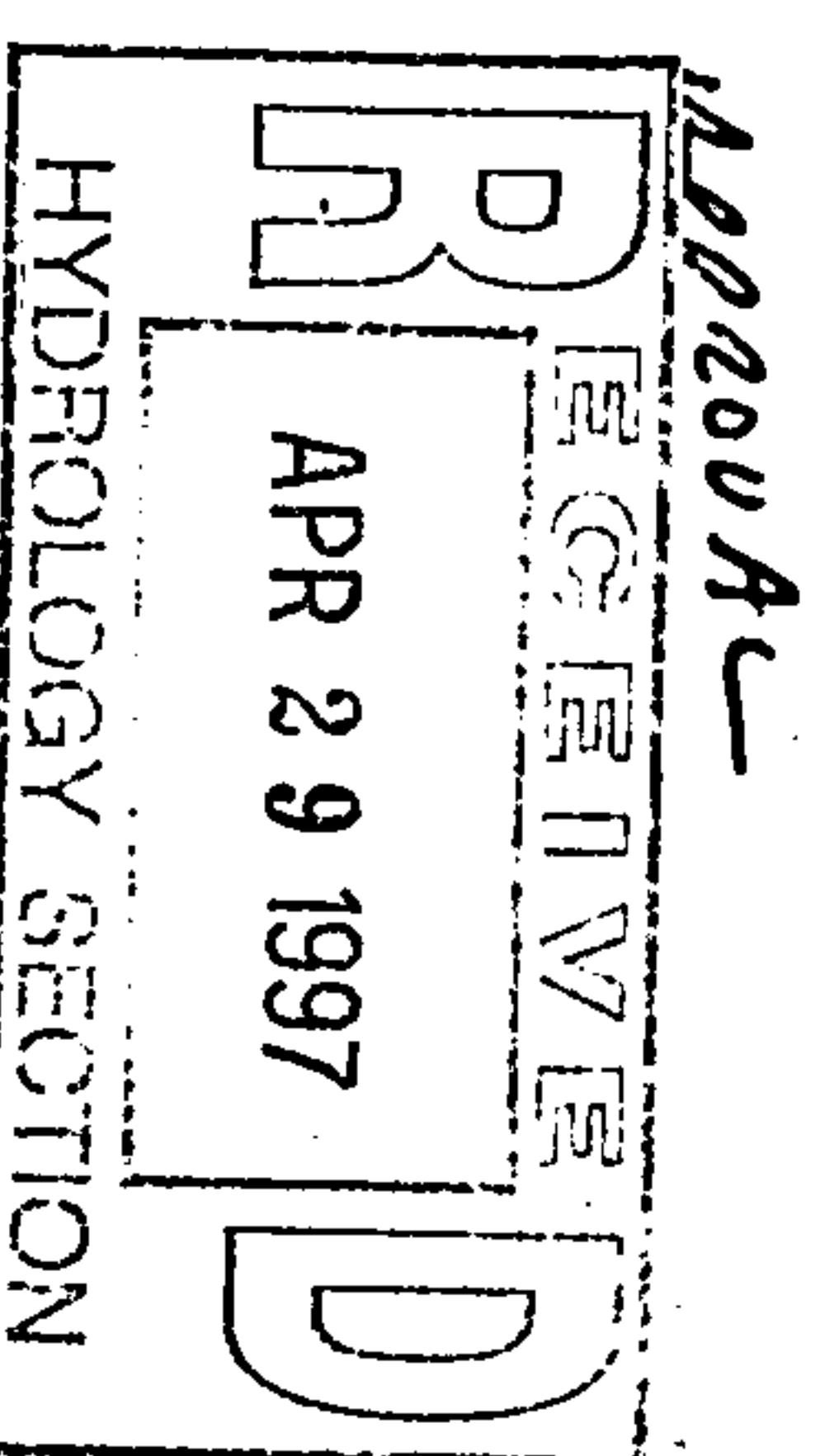
☒ YES

☐ NO

☐ COPY PROVIDED

DATE SUBMITTED: 4/28/97

BY: _____



**DRAINAGE REPORT
FOR
RON JOHNSON PRIVATE ACCESS ROAD
FOUR HILLS VILLAGE
CITY OF ALBUQUERQUE**

Prepared for
Ron Johnson
1124 Monte Largo N.E.
Albuquerque, New Mexico 87108

Prepared by:
Ryals Engineering and Constructors Services Co.
5301 Central N.E., Suite 913
Albuquerque, N.M. 87108

Robert B. Ryals, P.E.

Robert B. Ryals 4-25-97

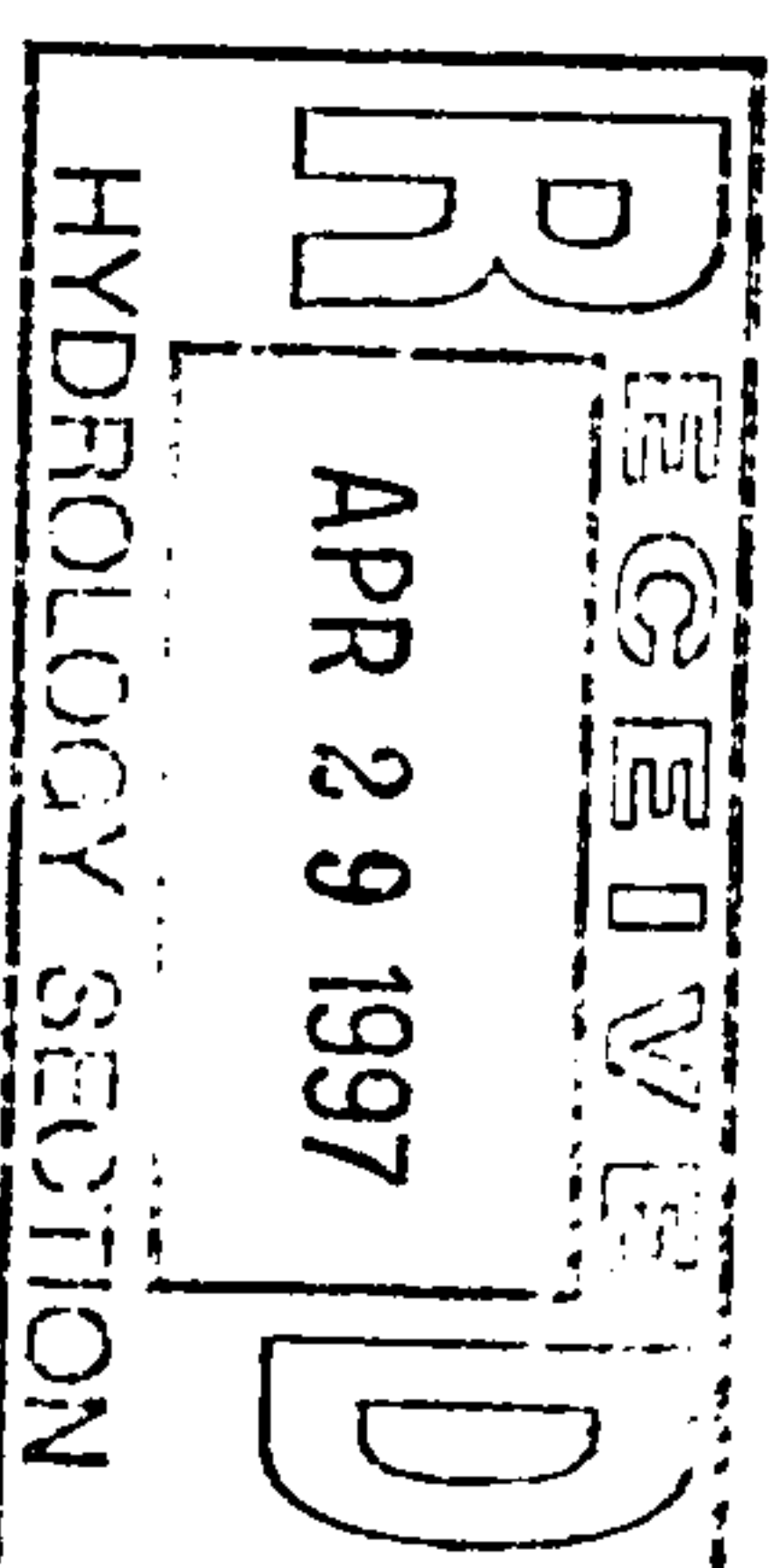
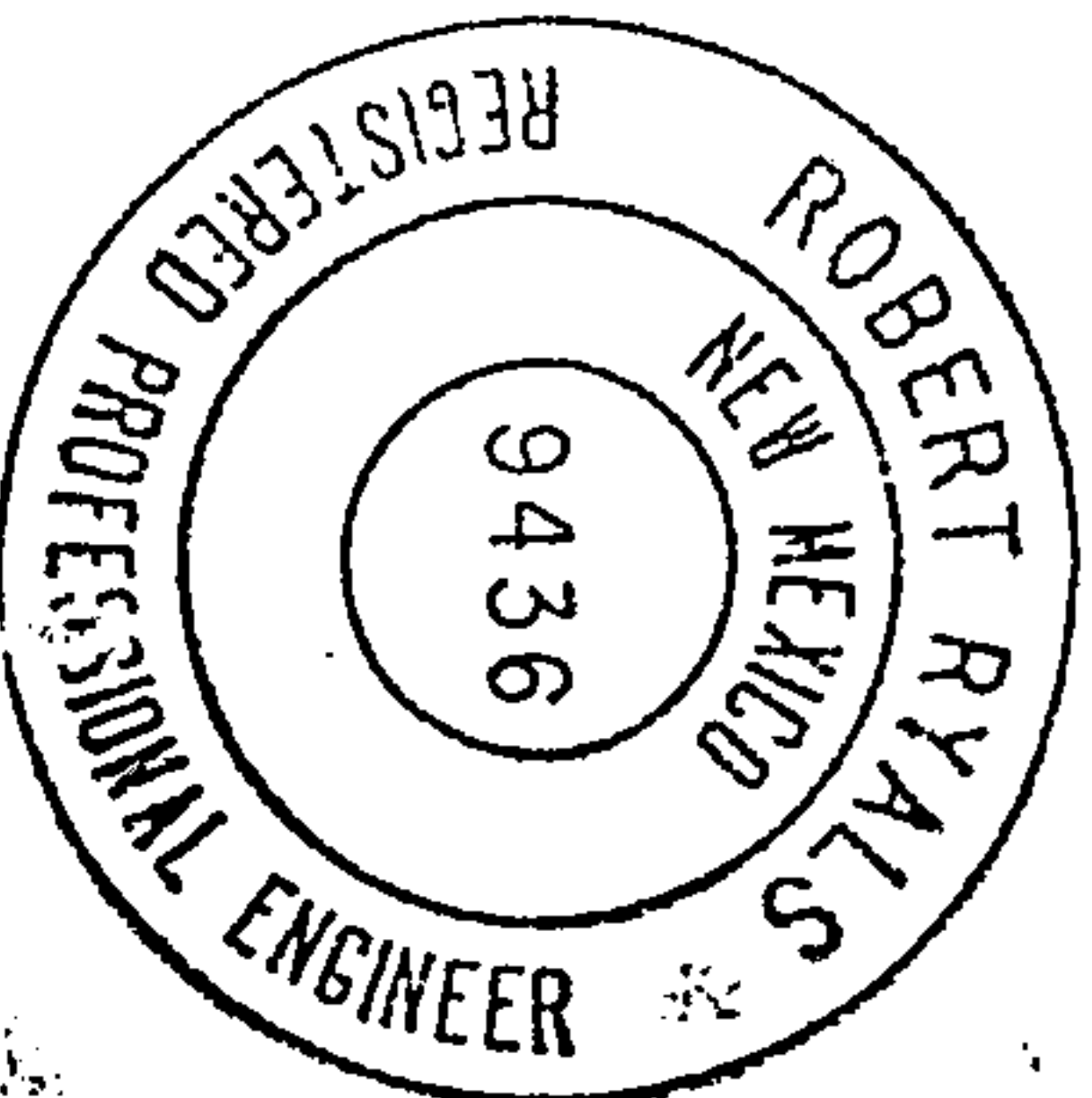


TABLE OF CONTENTS

DRAINAGE REPORT

- Introduction
- Existing Conditions
- Developed Conditions
- Recommendations
- Table I - Revised Hydrology
- Table II - Pipe Culvert Analysis
- Tables III thru VI - Trapezoidal channel analyses

EXHIBITS

- 1. Plat Map of Study Area
- 2. Drainage Analysis of Developed Additions
- 3. Paving Plan and Profile Drawing
- 4. Detail sheet

APPENDIX

- 1. Drainage Report for Four Hills Village 18th
Installation, Dated November 1978, by
Andrews, Asbury & Robert, Inc.

**DRAINAGE REPORT
FOR
RON JOHNSON ACCESS ROAD
FOUR HILLS VILLAGE
CITY OF ALBUQUERQUE**

Prepared by Ryals Engineering and Construction Service Company
January 23, 1996
Revised April 25, 1997

INTRODUCTION

Mr. Ron Johnson proposes building a public road along a public right-of-way within the 11th Installment of Four Hills Village in the extreme southeast quadrant of the City of Albuquerque (City Zone Map M23). The plat for study area is contained in Exhibit No. 1. The proposed road will cross over the Four Hills Diversion Channel at the right-of-way of Stagecoach Road. The road will then follow the La Cabra Drive right-of-way east to the municipal boundary. This road is needed to access unplatted property owned by Mr. Johnson.

This report presents the storm drainage analysis done to determine the size and quantity of culverts needed to safely pass the 100-year frequency flood flow at the access road crossing of the diversion channel.

EXISTING CONDITIONS

The basis for this report is a drainage report prepared in November 1978 by Andrews, Asbury & Robert, Inc. (AAR) for Paul's Homes, Inc. of Albuquerque. This report is enclosed as Appendix No. 1.

Briefly summarizing the AAR report, a development company, Paul's Homes, wanted to develop land for a subdivision within Four Hills Village, 19th Installment. AAR analyzed both onsite and offsite drainage in the vicinity of the proposed subdivision. Offsite drainage (see exhibit #2) included runoff into the future Four Hills Diversion Channel. Subbasins D-3 through D-8 delineated in that report, form the watershed that generates all the runoff into the diversion channel at the location of the proposed access road crossing.

Subbasins D-3 through D-8 are characterized by soil uncompacted by human activity on slopes of 10-20 percent. These subbasins have remained relatively undisturbed since the AAR report was prepared. Therefore, the hydrologic analysis performed for this study, only updates the analysis presented in the AAR report in order to be in conformance with the current City of Albuquerque, DPM standards (Section 22.2-2, January 1993). Table 1 presents the results of the 100-year flood frequency by subbasin. The total discharge calculated for the 71.8 acre drainage area was 186.7

cfs. The AAR report had calculated a total discharge of 179.5 cfs.

The Four Hills Diversion Channel intercepts major runoff flows east of the Four Hills Village. The channel, which directs the flow in a southerly direction toward the Four Hills Arroyo, is approximately 2,800 feet long and runs from north to south. The western side of the ditch, which protects Four Hills Village, has a berm of 4 feet in height and a top width of 12 to 15 feet. The eastern side does not have a berm. The channel and the land to east side are designated as Open Space.

DEVELOPED CONDITIONS

The access road will be a 3" City of Albuquerque standard residential pavement section with standard curb and gutter. The proposed method to carry storm water flow at the access road crossing is by using reinforced concrete pipe (r.c.p.). To determine the size and quantity of r.c.p. that will be needed, an analysis of existing channel capacity was conducted. Several channel sections up and downstream of the Stagecoach road right-of-way were surveyed. Typically, these channel sections had side slopes of 3:1, depths of 4 feet from flowline to top of berm, and bottom widths that varied from 12 to 20 feet. The average channel slope was approximately 0.25%. Normal depth calculations were made at several of the cross-sections. Flow was determined to be subcritical with an average normal depth of approximately 2.4 ft. This figure was used as the tailwater depth in the culvert analysis.

An 83-ft. long culvert will be needed to accommodate the roadway width. Several pipe sizes and quantities were looked at that would contain the full 100-year flow. It was determined that two 54" diameter pipes could contain the entire 186.7 cfs. flow without overtopping the crown. The Table 2 summarizes the pipe flow analysis for several discharges for a 54" r.c.p.

RECOMMENDATIONS

Two 54" r.c. pipes will be constructed to contain the 100-year flow. The existing berm along the western side of the channel will be raised to accommodate the extra height of the culverts. The raised portion of the berm will be extended north approx. 200 feet from the road centerline. This is to ensure that the berm is not overtopped by the 100-year event, two-thirds of whose volume enters the drainage easement via an arroyo from the east at this point. The top of berm elevation at 5973 will provide more than one foot of freeboard above the calculated 100-year event level (5971.33) upstream of the r.c.pipes. The minimum fill covering the pipes will be two feet. The two culverts will be 83 feet long and projecting at each end from the roadfill. The surface of the roadfill will be protected from erosion by soil cement. Exhibit No.3 is the paving plan and profile for the proposed project. Exhibit No. 4 is the detail sheet showing the r.c.p. layout and sections of the soil cement structures.

The bed of the existing channel is to be protected from scour by one foot thick soil

cement extending twenty feet from the upstream and downstream ends of the 54" pipes. Two foot deep cut-off walls will protect the soil cement from being undermined. An analysis of the existing channel performance at baseline station 1+00 (near the south end of the soil cement structure) at 100-year event conditions indicates the flow velocity to be 3.1 fps. An analysis of the proposed 54" pipes shows flow velocity to be 8-9 fps, depending on the tailwater depth. Assuming the flow uniformly fills the channel at baseline station 1+20 (the end of the proposed soil cement structure) this velocity drops to 4.1 fps, a nominal overall increase. Tables III-VI summarizes these pipe and channel flow analyses.

TABLE 1.

FILE = RONJON.WQ1

ALBUQUERQUE, NM, DPM (1/93) CRITERIA - SIMPLE PROCEDURE FOR <= 40 ACRES

PX100-6 = PRECIPITATION EXCESS FROM 100-YEAR 6-HOUR STORM

VOL10D = VOLUME OF RUNOFF FROM 100-YEAR 10-DAY STORM

TRMT CLASS A=UNDISTURBED, B=LAWNS, C=UNPAVED ROADS, D=ROOFS, PAVEMENT

SEE DPM P 22.5-5

***** PROJECT INFO *****

RON JOHNSON PROJECT
CITY OF ALBUQUERQUEEXISTING CONDITIONS FROM "DRAINAGE REPORT FOR FOUR HILLS VILLAGE
19TH INSTALLMENT SITE IMPROVEMENTS (ANDREWS, ASBURY & ROBERT, INC.; NOV,1978)

RAIN ZONE 3

SEE DPM P 22.2-2

-100-YEAR PRECIPITATION (P) DEPTHS, INCHES

1 HR	6 HR	24 HR	4 DAY	10 DAY
2.14	2.60	3.10	3.95	4.90

01/08/96		02:21 PM EXISTING CONDITIONS - SUBBASIN D-3					
TRMT	AREA	AREA	PX100-6	QP100-6	QP100-6	VOL6HR	
CLASS	SQUARE FT.	ACRES	IN/AC	CFS/AC	CFS	AC-FT	
A	0.00	0.0000	0.66	1.87	0.000	0.000	
B	217800.90	5.0000	0.92	2.60	13.000	0.383	
C	0.00	0.0000	1.29	3.45	0.000	0.000	
D	0.00	0.0000	2.36	5.02	0.000	0.000	
TOTAL	217800.90	5.0000			13.000	0.383	
					CU FT	16698	

01/08/96		02:21 PM EXISTING CONDITIONS - SUBBASIN D-4					
TRMT	AREA	AREA	PX100-6	QP100-6	QP100-6	VOL6HR	
CLASS	SQUARE FT.	ACRES	IN/AC	CFS/AC	CFS	AC-FT	
A	0.00	0.0000	0.66	1.87	0.000	0.000	
B	239581.00	5.5000	0.92	2.60	14.300	0.422	
C	0.00	0.0000	1.29	3.45	0.000	0.000	
D	0.00	0.0000	2.36	5.02	0.000	0.000	
TOTAL	239581.00	5.5000			14.300	0.422	
					CU FT	18368	

01/08/96		02:21 PM EXISTING CONDITIONS - SUBBASIN D-5					
TRMT	AREA	AREA	PX100-6	QP100-6	QP100-6	VOL6HR	
CLASS	SQUARE FT.	ACRES	IN/AC	CFS/AC	CFS	AC-FT	
A	0.00	0.0000	0.66	1.87	0.000	0.000	
B	82764.30	1.9000	0.92	2.60	4.940	0.146	
C	0.00	0.0000	1.29	3.45	0.000	0.000	
D	0.00	0.0000	2.36	5.02	0.000	0.000	
TOTAL	82764.30	1.9000			4.940	0.146	
					CU FT	6345	

01/08/96		02:21 PM EXISTING CONDITIONS - SUBBASIN D-6					
TRMT	AREA	AREA	PX100-6	QP100-6	QP100-6	VOL6HR	
CLASS	SQUARE FEI	ACRES	IN/AC	CFS/AC	CFS	AC-FT	
A	0.00	0.0000	0.66	1.87	0.000	0.000	
B	117612.50	2.7000	0.92	2.60	7.020	0.207	
C	0.00	0.0000	1.29	3.45	0.000	0.000	
D	0.00	0.0000	2.36	5.02	0.000	0.000	
TOTAL	117612.50	2.7000			7.020	0.207	
					CU FT	9017	

01/08/96 02:21 PM EXISTING CONDITIONS - SUBBASIN D-7

TRMT	AREA	AREA	PX100-6	QP100-6	QP100-6	VOL6HR
CLASS	SQUARE FEI	ACRES	IN/AC	CFS/AC	CFS	AC-FT
A	0.00	0.0000	0.66	1.87	0.000	0.000
B	191664.80	4.4000	0.92	2.60	11.440	0.337
C	0.00	0.0000	1.29	3.45	0.000	0.000
D	0.00	0.0000	2.36	5.02	0.000	0.000
TOTAL	191664.80	4.4000			11.440	0.337
					CU FT	14694

01/08/96 02:21 PM EXISTING CONDITIONS - SUBBASIN D-8

TRMT	AREA	AREA	PX100-6	QP100-6	QP100-6	VOL6HR
CLASS	SQUARE FEI	ACRES	IN/AC	CFS/AC	CFS	AC-FT
A	0.00	0.0000	0.66	1.87	0.000	0.000
B	2278197.10	52.3002	0.92	2.60	135.981	4.010
C	0.00	0.0000	1.29	3.45	0.000	0.000
D	0.00	0.0000	2.36	5.02	0.000	0.000
TOTAL	2278197.10	52.3002			135.981	4.010
					CU FT	174662

01/08/96 02:21 PM EXISTING CONDITIONS - TOTAL RUNOFF (D-3 THRU D-8)

TRMT	AREA	AREA	PX100-6	QP100-6	QP100-6	VOL6HR
CLASS	SQUARE FEI	ACRES	IN/AC	CFS/AC	CFS	AC-FT
A	0.00	0.0000	0.66	1.87	0.000	0.000
B	3127620.00	71.8003	0.92	2.60	186.681	5.505
C	0.00	0.0000	1.29	3.45	0.000	0.000
D	0.00	0.0000	2.36	5.02	0.000	0.000
TOTAL	3127620.00	71.8003			186.681	5.505
					CU FT	239784

TABLE II **PIPE CULVERT ANALYSIS** **COMPUTATION OF CULVERT PERFORMANCE CURVE**

April 23, 1997
Ron Johnson Channel Study
54" RCP Culvert
Total Q=187 CFS (100-Year Event): 2 Culverts

PROGRAM INPUT DATA:	VALUE
Culvert Diameter (feet).....	4.50
FHWA Chart Number (1,2 or 3).....	3
Scale Number on Chart (Type of Culvert Entrance).....	2
Manning's Roughness Coefficient (n-value).....	0.0130
Entrance Loss Coefficient of Culvert Opening.....	0.20
Culvert Length (feet).....	80.0
Culvert Slope (feet per foot).....	0.0020

PROGRAM RESULTS:							
Flow Tailwater Rate (cfs)	Depth (ft)	Inlet Control	Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
93.5	2.00	4.16	4.33	4.03	2.84	2.84	8.85
93.5	2.50	4.16	4.33	4.03	2.84	2.84	8.85
93.5	3.00	4.16	4.33	4.03	2.84	3.00	8.30
93.5	3.50	4.16	4.33	4.03	2.84	3.50	7.04
93.5	4.00	4.16	4.66	4.03	2.84	4.00	6.26
93.5	4.50	4.16	5.16	4.03	2.84	4.50	5.88

=====

PIPE CULVERT ANALYSIS COMPUTER PROGRAM Version 1.7 Copyright (c)1986
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Table III

TRAPEZOIDAL CHANNEL ANALYSIS NORMAL DEPTH COMPUTATION

April 23, 1997
Ron Johnson Channel Study
Existing Channel Cross-section
B1 Sta 1+00

PROGRAM INPUT DATA: DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	187.0
Channel Bottom Slope (feet per foot).....	0.0005
Manning's Roughness Coefficient (n-value).....	0.0220
Channel Side Slope - Left Side (horizontal/vertical).....	3.00
Channel Side Slope - Right Side (horizontal/vertical)...	3.00
Channel Bottom Width (feet).....	20.0

PROGRAM RESULTS: DESCRIPTION	VALUE
Normal Depth (feet).....	2.72
Flow Velocity (feet per second).....	2.44
Froude Number (Flow is Sub-Critical).....	0.297
Velocity Head (feet).....	0.09
Energy Head (feet).....	2.81
Cross-Sectional Area of Flow (square feet).....	76.54
Top Width of Flow (feet).....	36.31

=====

TRAPEZOIDAL CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.3 (c) 1986
Dodson & Associates, Inc., 7015 W. Tidwell, #107, Houston, TX 77092
(713) 895-8322. A manual with equations & flow chart is available.

TABLE IV

TRAPEZOIDAL CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

April 23, 1997
Ron Johnson Channel Study
Proposed Channel Cross-section
B1 Sta 1+20=end soil cement structure

```
=====
PROGRAM INPUT DATA:
DESCRIPTION                                     VALUE
-----
Flow Rate (cubic feet per second)..... 187.0
Channel Bottom Slope (feet per foot)..... 0.0005
Manning's Roughness Coefficient (n-value)..... 0.0150
Channel Side Slope - Left Side (horizontal/vertical).... 2.00
Channel Side Slope - Right Side (horizontal/vertical).... 3.00
Channel Bottom Width (feet)..... 20.0
=====
```

```
PROGRAM RESULTS:
DESCRIPTION                                     VALUE
-----
Normal Depth (feet)..... 2.24
Flow Velocity (feet per second)..... 3.26
Froude Number (Flow is Sub-Critical)..... 0.424
Velocity Head (feet)..... 0.174
Energy Head (feet)..... 2.41
Cross-Sectional Area of Flow (square feet)..... 57.34
Top Width of Flow (feet)..... 31.20
=====
```

=====

TRAPEZOIDAL CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.3 (c) 1986
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(713) 895-8322. A manual with equations & flow chart is available.

Table V

TRAPEZOIDAL CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

April 23, 1997
Ron Johnson Channel Study
Existing Channel Cross-section
B1 Sta 1+00

PROGRAM INPUT DATA:
DESCRIPTION

DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	187.0
Channel Bottom Slope (feet per foot).....	0.0010
Manning's Roughness Coefficient (n-value).....	0.0220
Channel Side Slope - Left Side (horizontal/vertical)....	3.00
Channel Side Slope - Right Side (horizontal/vertical)...	3.00
Channel Bottom Width (feet).....	20.0

PROGRAM RESULTS:
DESCRIPTION

DESCRIPTION	VALUE
Normal Depth (feet).....	2.25
Flow Velocity (feet per second).....	3.11
Froude Number (Flow is Sub-Critical).....	0.409
Velocity Head (feet).....	0.15
Energy Head (feet).....	2.40
Cross-Sectional Area of Flow (square feet).....	60.13
Top Width of Flow (feet).....	33.49

TRAPEZOIDAL CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.3 (c) 1986
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(713) 895-8322. A manual with equations & flow chart is available.

TABLE IV TRAPEZOIDAL CHANNEL ANALYSIS NORMAL DEPTH COMPUTATION

April 23, 1997
 Ron Johnson Channel Study
 Proposed Channel Cross-section
 B1 Sta 1+20=End Soil Cement Structure

PROGRAM INPUT DATA: DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	187.0
Channel Bottom Slope (feet per foot).....	0.0010
Manning's Roughness Coefficient (n-value).....	0.0150
Channel Side Slope - Left Side (horizontal/vertical)....	2.00
Channel Side Slope - Right Side (horizontal/vertical)...	3.00
Channel Bottom Width (feet).....	20.0

PROGRAM RESULTS: DESCRIPTION	VALUE
Normal Depth (feet).....	1.84
Flow Velocity (feet per second).....	4.13
Froude Number (Flow is Sub-Critical).....	0.584
Velocity Head (feet).....	0.26
Energy Head (feet).....	2.11
Cross-Sectional Area of Flow (square feet).....	45.30
Top Width of Flow (feet).....	29.21

TRAPEZOIDAL CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.3 (c) 1986
 Dodson & Associates, Inc., 7015 W. Tidwell, #107, Houston, TX 77092
 (713) 895-8322. A manual with equations & flow chart is available.

APPENDIX

Drainage Report
Four Hills Village Installment 19
Prepared by Andrews Asbury and Robert, Inc.
Date of Report: November 1978

INCLUDED FOR REFERENCE ONLY

PAUL'S HOMES, INC.
ALBUQUERQUE, NEW MEXICO

DRAINAGE REPORT
FOR
FOUR HILLS VILLAGE
: NINETEENTH INSTALLMENT
SITE IMPROVEMENTS

NOVEMBER 1978

ANDREWS, ASBURY & ROBERT, INC.
Consulting Engineers
401 San Pedro, N. E.
Albuquerque, New Mexico 87108
505-265-6631

DRAINAGE REPORT
FOR
FOUR HILLS VILLAGE
NINETEENTH INSTALLMENT
SITE IMPROVEMENTS

TABLE OF CONTENTS

	<u>PAGE</u>
I Introduction	1
II Existing Conditions	2
A. Off site Drainage	2
B. On site Drainage	4
III Developed Conditions	5
A. Four Hills Diversion Ditch	5
B. Four Hills Arroyo	6
C. On site Drainage control	7
IV Lot Ponding Requirements	8
<u>MAPS</u>	
Location Map	Map No. 1
Off site Drainage	Map No. 2
V Design Analysis	11
	Sheets 1 through 30
<u>MAPS</u>	
Existing Conditions	Map No. 3
Developed Conditions	Map No. 4
(See special pocket at back of report for Map No. 3 and Map No. 4)	

I

INTRODUCTION

Paul's Homes, Inc. proposes to improve and develop a 53.7 acre tract of land designated as Four Hills Village, Nineteenth Installment, a subdivision located in the far southeast quadrant of the City of Albuquerque. This subdivision is bounded on the south by lands of Kirtland Air Force Base, on the west by Four Hills Village, Installment Seventeen, and on the north and east by Four Hills Village, Installments Eleven, Twelve and Thirteen. (See enclosed Location Map, Map No. 1, page M-23 of the Zone Atlas.)

The storm drainage analysis included in this drainage report was made to determine the storm water runoff anticipated in the event of a 100-year frequency storm and to provide a plan to control storm water runoff under the proposed developed conditions that will conform to applicable drainage resolutions and ordinances.

In order to provide a comprehensive drainage analysis for the Nineteenth Installment it was necessary to study the surrounding and adjacent platted subdivisions including portions of the 11th, 12th, 13th, 17th and 5th Installments of Four Hills Village. The results of this study are included in this report.

II

EXISTING CONDITIONS

The Four Hills Village, Nineteenth Installment subdivision, consists of ground surfaces relatively broken and steep having grades varying from 4% to 7% and presently undeveloped. However, the area lying directly to the west, north, and along the major portion of the east side is in a developed condition. All adjacent development is in residential use.

The south side of the subdivision is bounded by lands of Kirtland Air Force Base. These lands are completely undeveloped and exist in a natural and native condition.

One of the main drainage features of this subdivision consists of a major arroyo, hereinafter referred to as the Four Hills Arroyo, that bisects the subdivision in a southeasterly-northwesterly direction.

A. OFFSITE DRAINAGE

Offsite areas generating storm water runoff to the subdivision are located northeast, east and southeast of the subdivision site and are shown on Map No. 2 and Map No. 3 enclosed herein.

A runoff factor (c) of 0.50 was chosen for use in

determining the runoff rate from offsite drainage areas. This runoff factor determination was based on site field investigations of the areas. The developed areas have a reasonable amount of built-in rear or side yard ponding and sometimes the front yard, to compensate in the majority of the area for the increased rate of runoff created by the hard surface areas. The developed areas combined with the undeveloped areas that have a fairly open graded soil and good vegetative cover allow the factor as chosen to be considered conservative.

1. FOUR HILLS ARROYO - OFFSITE AREA

The offsite drainage area of the Four Hills Arroyo consists of 603.3 acres and is shown on Map No. 2. Limits of the drainage area were determined from Kirtland Base engineer topographic maps. These maps are at a scale of 1" = 200' with contour intervals of 2 feet and were made available by the Albuquerque Metropolitan Arroyo Flood Control Authority. Prints of such maps are on file at the AMAFCA office.

2. OTHER OFFSITE AREAS

The drainage area limits of the offsite areas other than the Four Hills Arroyo were determined from a combination of methods. Orthophoto topographic mapping at a scale of 1" = 200' was utilized where such mapping was available. The remainder of the area limits was determined from USGS topographic maps at a scale of 1" = 2000' along with field site investigations.

As a result of the study made of the offsite drainage areas it was determined that some existing streets in the Four Hills area are unable to carry the flows generated by a 100-year frequency storm and that some residences in the area are subject to flooding conditions by storms of a much lesser magnitude.

B. ON SITE DRAINAGE

On site drainage under existing conditions is shown on Map No. 2 enclosed herein. The on site drainage north and east of the Four Hills Arroyo is carried to the arroyo by natural drainage channels.

The southwest portion of the subdivision site drains into the 17th Installment street system. The present street system carries the flows west and north to a lined drainage easement channel that empties into the Four Hills Arroyo. (See Map No. 2).

The drainage analysis and computations are included hereinafter in this report.

III

DEVELOPED CONDITIONS

The proposed method of both on site and off site drainage for the subdivision under developed conditions is shown on Map No. 4 enclosed herein.

A. FOUR HILLS DIVERSION DITCH

As shown on Map No. 4 it is proposed to build a diversion ditch approximately 2800 feet in length, herein- after referred to as Four Hills Diversion Ditch, along a north-south alignment and located east of the Four Hills Village area. This diversion ditch will intercept all major runoff flows from the off site drainage areas to the east and direct them southerly to the Four Hills Arroyo.

Permission to construct approximately 300 feet of the diversion ditch on the lands of Kirtland Air Force Base has been formally requested by the City of Albuquerque from the Base Engineer approximately 60 days ago. At the time of this writing an answer has not been received as to whether permission will be granted to extend the outlet of the diversion ditch onto Kirtland Base lands. Indications are that permission will be granted.

An alternate to construction of the outlet of the

diversion ditch on the lands of Kirtland Air Force Base would be the construction of a concrete lined channel along the southerly boundary of the subdivision. Limits of this concrete lined channel would be from the point of intersection of the diversion ditch with the north boundary of Kirtland Base, westerly to the Four Hills Arroyo. (See Map No. 4.)

B. FOUR HILLS ARROYO

As shown on Map No. 4 it is proposed to provide channelization and improvements to the Four Hills Arroyo through the 19th Installment and to the west along the north boundary of the 17th Installment.

Improvements of the arroyo in the 19th Installment include bank protection to confine the flows within the dedicated drainage right-of-way. This bank protection will be provided along the banks of the arroyo between the existing rock outcroppings and will consist of dikes with wire tied rip rap for erosion protection. Other than this bank protection, the arroyo shall be left in its natural state including preservation of the existing vegetation during construction.

Improvements of the arroyo along the north boundary of the 17th Installment consist of constructing a concrete lined channel. Concrete lining of the arroyo along this reach is necessary due to the encroachment of fill into the arroyo

during grading operations performed when developing the 17th
Installment. Limits of the proposed lining are shown on Map
No. 4.

A drainage structure (dry weather crossing) consisting of five (5) 60-inch diameter culvert pipe is proposed to be constructed for the Wagontrain Drive crossing of the arroyo. Erosion protection upstream and downstream of the structure should be provided.

C. ON SITE DRAINAGE CONTROL

Guidelines to be used in controlling storm water runoff when developing the subdivision shall be as follows:

1. Provide for backyard and/or roof ponding as necessary so as not to increase the volume and rate of runoff due to development of the subdivision. Consideration shall be given to the fact that due to the steep terrain on which this subdivision is located, ponding cannot be accomplished on some lots. However, in considering the total area of the subdivision there shall be sufficient total ponding provided so as not to increase runoff due to development of the subdivision.

2. Runoff and ponding determinations shall be made based on the following surfaces or equivalent.

Front yard and street area	
Hard surfaced area	50%
Landscaped area	50%
Back yard area	
Hard surfaced area	18%
Landscaped area	82%

IV

LOT PONDING REQUIREMENTS

Units to be constructed on lots in this subdivision will consist of residential units varying in size from 2000 ft² to 3000 ft².

The basis and factors for determining lot ponding requirements are shown on sheet 15 of the design analysis. From this sheet 15, the volume per square foot of lot area to be ponded is 0.108 ft³.

Following is a tabulation of the lot ponding requirements:

FOUR HILLS VILLAGE 19th INSTALLMENT

LOT PONDING REQUIREMENTS

Block	Lot No.	Storage Volume (CF)
17-A	42	1268
	43	1429
	44	916
	45	1026
	45	1134
	47	1242
	48	1441
	49	2453
	50	838
	51	1613
17-A		
45-A	21	1199
	22	850
	23	1354
	24	1029
	25	1476
	26	-0-
	27	-0-

LOT PONDING REQUIREMENTS
(Continued)

Block	Lot No.	Storage Volume (CF)
45-A	28	1134
	29	893
	30	1121
	31	1287
	32	1188
	33	1188
	34	1188
	35	1188
	36	1188
	37	1188
48-A	11	-0-
	12	1381
	13	1460
	14	699
	15	-0-
	16	-0-
	17	1307
48-A	18	1083
	19	1294
	20	-0-
	21	-0-
	21	-0-
49-A	3	865
	4	1257
	5	1916
	6	1329
	7	950
	8	950
	9	950
	10	950
	11	975
	12	1107
49-A	13	1892
	14	1772
	15	1188
	16	1188
	17	1188
	18	626
	19	551
	20	-0-
	21	-0-
	22	-0-
49-A	23	-0-
	24	2226

LOT PONDING REQUIREMENTS
(Continued)

Block	Lot No.	Storage Volume (CF)
50-A	2	549
	3	662
	4	954
	5	1001
	6	739
	7	972
	8	972
	9	972
	10	811
	11	1865
	12	1339
50-A	22	731
51-A	23	2129
	24	-0-
	25	-0-
	26	-0-
51-A	27	1755
54-A	22	1026
	23	1080
	24	1080
	25	864
	26	1688
	27	886
	28	799
	29	799
	30	799
	31	799
	32	-0-
54-A	33	3313
	34	1522
	35	1242
	36	2339
	37	-0-
	38	-0-
	39	1970
	40	1487
	41	1459
	42	794
	43	616
54-A	44	-0-
	45	864
	46	864
	47	-0-
	48	-0-
54-A	49	-0-

V

DESIGN ANALYSIS

Included hereinafter are the drainage analyses
(computations) for the subject subdivision. (See sheets
1 through 30).

FOUR HILLS VILLAGE
NINETEENTH INSTALLMENT
SITE IMPROVEMENTS

DRAINAGE ANALYSIS

Sheet

Criteria, Reference Material
and Design Parameters

1

EXISTING CONDITIONS

Drainage Area	A	2
	B	3
	C	3
	D	4
	E	4
Four Hills Arroyo		5

DEVELOPED CONDITIONS

Four Hills Diversion Ditch	8
Individual Areas	8 - 10
Combined Areas	11 - 13
Lot Runoff Factors & Ponding Factors	14 - 15
Drainage Area C	
Street Flows	16
Drainage Area D	
Street & Easement Flows	17 - 18
Drainage Area E	
Street & Easement Flows	19
Four Hills Arroyo	20 - 22

FACILITY DESIGN

Four Hills Diversion Ditch	23 - 24
Four Hills Arroyo	25 - 27
Camino Cerrito	28
Drainage Easement Channel, Lots 43 & 44, Blk 17	29
Conestoga Drive Cul de Sac	30

DRAINAGE ANALYSIS

CRITERIA-

DESIGN STORM - 100 Year Frequency

REFERENCE MATERIAL

1. Albuquerque Area (1961) Intensity Duration - Frequency Curves
2. 100 Year - 6 Hour Precipitation Rainfall Frequency Map for New Mexico - U.S. Weather Bureau. 1967
3. Time of Concentration Nomograph by P.Z. Kiprich.

DESIGN PARAMETERS

Peak Runoff Rate - Rational Formula
 $Q = CIA$

Runoff Volume. $V = \text{Runoff Coefficient} \times \text{Rainfall} \times \text{Area}$

Runoff Coefficients

Offsite & Existing Conditions = 0.50
Hard Surface = 0.90
Landscaped Surface = 0.40

ANDREWS, ASBURY & ROBERT, INC.
CONSULTING ENGINEERS
401 San Pedro, NE., Albuquerque, N.M., 87108
Telephone (505) 265-6631

Project FOUR HILLS VILLAGE Sheet 2 of 30
19 TH INSTALLMENT Job No. 130
By JM Chkd _____ Date 11-28-73

EXISTING CONDITIONS

For offsite drainage Areas - See Map No. 2
and for on site drainage Areas - See Map No. 3.

Drainage Area A -

@ South Boundary of 19th Installment.

Area = 603.3 Acres

To determine (T_c) Time of Concentration
Drainage Area is divided into
four reaches.

<u>Reach</u>	<u>Length</u>	<u>Elev. High - Low</u>	<u>Elev. Diff.</u>	<u>T_c</u>
1	1200'	6580-6400	180'	5 min.
2	1000'	6400-6320	80'	6 "
3	3500'	6320-6080	240'	9 "
4	3700'	6080-5896	184'	10 "
Total				$T_c = 30 \text{ min.}$

$$I = 3.44, \quad C = 0.50$$

$$Q = (0.50)(3.44)(603.3) = \underline{\underline{1038 \text{ CFS}}}$$

@ South Endry of
Subdivision.

EXISTING CONDITIONS. CONT'D

Drainage Area B.

@ Entrance to Four Hills Arroyo -
See Map No. 3

Area = 21.1 Acres

Length of Area = 2800'

Elev. Diff = 6028 - 5857 = 171'

$T_c = 11 \text{ min.}$ $I = 5.25$

$$Q = (0.50)(5.25)(21.1) = \underline{\underline{55 \text{ CFS}}}$$

DRAINAGE AREA C

@ Entrance to Four Hills Arroyo
Near Wagontrain Drive - See Map No. 2
and Map No. 3.

Area = 117.0 Acres

Drainage Area is divided into 3 reaches

Reach	Length	Elev High - Low.	Elev. Diff	T_c
1	500'	6560 - 6400	160'	3 min
2	4700'	6400 - 5966	434'	12 "
3	2450'	5966 - 5827	139'	6 "

Total $T_c = 21 \text{ min.}$

$I = 3.9$

$$Q = (0.50)(4.1)(117.0) = \underline{\underline{240 \text{ CFS}}}$$

EXISTING CONDITIONS - CONT'D

DRAINAGE AREA D

@ Entrance to Four Hills Arroyo Southwest of Camino Cerrito & Caballero Drive.

Area = 154.6 Acres

Drainage Area is divided into 3 reaches.

<u>Reach</u>	<u>Length</u>	<u>Elev. High</u>	<u>Elev. Low</u>	<u>Elev. Diff</u>	<u>Tc</u>
1	4000'	6330	5968	362	12 min.
2	1800'	5968	5846	122	7 min.
3	1700'	5846	5789	57	6 min.

Total Tc = 25 min.

I = 3.9

$$Q = (0.50)(3.9)(154.6) = \underline{\underline{301 \text{ CFS}}}$$

DRAINAGE AREA E

@ Entrance of drainage channel in 17th Installment North of Caballero Rd & Cotton Avenue Intersection.

Area = 41.6 Acres

Length Drainage Area = 3870'

Elev. Diff = 5896 - 5746 = 150' Tc = 11 min.

I = 5.25

$$Q = (0.50)(5.25)(41.6) = \underline{\underline{109 \text{ CFS}}}$$

EXISTING CONDITIONS CONT'D

FLOW RATES IN FOUR HILLS ARROYO

Combined Drainage Areas A, B, A-1 & A-2

@ Wagontrain Drive

$$\text{Area} = 603.3 + 21.1 + 8.3 + 3.4 = 636.1 \text{ Acres}$$

Tc of Area A plus channel flow time

$$= 30 \text{ min} + 2 \text{ min} = 32 \text{ min.}$$

$$I = 3.32$$

$$Q = (0.50)(3.32)(636.1) = \underline{\underline{1056 \text{ CFS}}}$$

Combined Drainage Areas

A, B, A-1, A-2, C & A-3

@ Boundary of 19th Installment & 17th Install.

$$\text{Area} = 636.1 + 117.0 + 7.5 = 760.6 \text{ Acres}$$

Tc = Above tc plus channel flow time

$$= 32 \text{ min.} + 1 \text{ min} = 33 \text{ min.}$$

$$I = 3.26$$

$$Q = (0.50)(3.26)(760.6) = \underline{\underline{1240 \text{ CFS}}}$$

EXIST. CONDITIONS - CONT'D -

Combined Drainage Areas

A, B, A-1, A-2, C, A-3 & D

@ entrance of flow from drainage Area D.

$$\text{Area} = 760.6 + 154.6 = 915.2$$

$$T_c = \text{Same as above} = 33 \text{ min} - I = 3.26$$

$$Q = (0.50)(3.26)(915.2) = \underline{\underline{1492 \text{ CFS}}}$$

Combined Drainage Areas -

Same as above plus A-4 & E.

@ point where flow from 17th Installment enters Four Hills Arroyo

$$\text{Area} = 915.2 + 8.3 + 41.6 = 965.1$$

$$T_c = \text{Above } T_c + \text{Channel Flow time} =$$

$$= 33 \text{ min} + 2 = 35 \text{ min.}$$

$$I = 3.15$$

$$Q = (0.50)(3.15)(965.1) = 1520 \text{ CFS}$$

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Project FERRO VILLAS APPROVED Sheet 7 of 30
19TH INSTALLMENT Job No. 130
By JH Chk'd — Date 11-23-78

EXISTING CONDITIONS. CONT'D

Combined Drainage Areas -

Total - A thru E including A-5

Area = 965.1 + 2.9 = 968 - Acres

T_c = Same as above = 35 min.

$I = 3.15$

$Q = (0.50)(3.15)(968) = \underline{\underline{1.525 \text{ CFS}}}$

NOTE

See Map No. 3 for Existing Condition
Flows & Areas,

DEVELOPED CONDITIONS

Following is the drainage analysis for the proposed developed & improved conditions- (See Map No. 4)

FOUR HILLS - DIVERSION DITCH

See MAP NO 4 for designation & location of Drainage Areas.

Drainage Area (DA) D-3

Area = 5.0 Acres

T_c = less than 10 min - Use $I = 5.4$

$C = 0.50$

$$Q = CIA = (0.50)(5.4)(5.0) = \underline{\underline{13.5 \text{ cfs}}}$$

DA - D-4

Area = 5.5 Ac.

$T_c < 10 \text{ min}$ - Use $I = 5.4$

$$Q = (0.50)(5.4)(5.5) = \underline{\underline{14.8 \text{ cfs}}}$$

DA - D-5

Area = 1.9 Ac. , $I = 5.4$

$$Q = (0.50)(5.4)(1.9) = \underline{\underline{5.1 \text{ cfs}}}$$

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Project FOUR HILLS Sheet 9 of 30
19TH INSTALLMENT Job No. 130
By JA Chkd ✓ Date 11-1-78

DIVERSION DITCH - CONT'D

DA - D-6

Area = 2.7 Acres, $I = 5.4$

$$Q = (0.50)(5.4)(2.7) = \underline{\underline{7.3 \text{ CFS}}}$$

DA - D-7

Area = 4.4 Acres, $I = 5.4$

$$Q = (0.50)(5.4)(4.4) = \underline{\underline{11.9 \text{ CFS}}}$$

DA - D-8

Area = 52.3 Acres

$$\text{Elev. Diff.} = 6330 - 5968 = 382'$$

$$\text{Length} = 4000'$$

$$T_c = 12 \text{ min.} \quad I = 5.0$$

$$Q = (0.50)(5.0)(52.3) = \underline{\underline{130.8 \text{ CFS}}}$$

DA - C-1

Area = 14.7 Acres, $I = 5.4$

$$Q = (0.50)(5.4)(14.7) = \underline{\underline{39.7 \text{ CFS}}}$$

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Project 4- HILLS Sheet 10 of 30
19TH INSTALMENT Job No. 13
By JA Chkd — Date 11-1-78

DIVERSION DITCH, CONT'D

DA - C-2

Area = 68.3 Acres

Elev. D.F. = Reach 1 - 6560-6400 = 160', 49, 500'

Reach 2 - 6400-5966 = 434', 49, 4700'

T_c = Reach 1 = 3 min.

Reach 2 = 12 min.

Total = 15 min, $I = 4.6$

$$Q = (0.50)(4.6)(68.3) = \underline{\underline{157.1 \text{ CFS}}}$$

DA - B-1

Area = 7.0 Acres, $I = 5.4$

$$Q = (0.50)(5.4)(7.0) = \underline{\underline{18.9 \text{ CFS}}}$$

DIVERSION DITCH — FLOW ANALYSIS

Flows from Drainage Areas D-3 through D-8, C-1 & C-2 and B-1 will be intercepted by the FOUR HILLS DIVERSION CHANNEL.

DA - D-3 - See Sheet 8

$$Q = \underline{\underline{13.5 \text{ CFS}}}$$

DA - D-3 & D-4

$$\text{Area} = 5.0 + 5.5 = 10.5 \text{ Acres,}$$

$$I = 5.4$$

$$Q = (0.50)(5.4)(10.5) = \underline{\underline{28.4 \text{ CFS}}}$$

DA - D-3, D-4 & D-5

$$\text{Area} = 10.5 + 1.9 = 12.4 \text{ Acres}$$

$$I = 5.4$$

$$Q = (0.50)(5.4)(12.4) = \underline{\underline{33.5 \text{ CFS}}}$$

DA - D-3 thru D-6

$$\text{Area} = 12.4 + 2.7 = 15.1 \text{ Acres}$$

$$T_c < 10 \text{ min. Use } I = 5.4$$

$$Q = (0.50)(5.4)(15.1) = \underline{\underline{40.8 \text{ CFS}}}$$

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Project FOUR HILLS Sheet 12 of 30
19 IN. INSTALLMENT Job No. 150
By JM Chkd ✓ Date 11-1-78

DIVERSION DITCH CONT'D

DA - D-3 THRU D-7

Area = 15.1 + 4.4 = 19.5 Acres

I = 5.4

$$Q = (0.50)(5.4)(19.5) = \underline{\underline{52.6 \text{ CFS}}}$$

DA - D-3 THRU D-8

Area = 19.5 + 52.3 = 71.8 Acres

T_c - Same as for Drainage Area D-3
= 12 min.

I = 5.0

$$Q = (0.50)(5.0)(71.8) = \underline{\underline{179.5 \text{ CFS}}}$$

DA - D-3 THRU D-8 & C-1

Area = 71.8 + 14.7 = 86.5 Acres

T_c = Same as above - 12 min. + channel
flow time.

Channel flow time = 900' @ 5 fps = 3 min.

T_c = 12 min + 3 min. = 15 min.

I = 4.6

$$Q = (0.5)(4.6)(86.5) = \underline{\underline{199.0 \text{ CFS}}}$$

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Project EL JICO HILLS

Sheet 13 of 30

19TH INSTALLMENT

Job No. 1500

By JAG

Chkd ✓

Date 11-1-78

DIVERSION DITCH CONT'D

DA - D-3 thru D-8 & C-1 & C-2.

Area = $86.5 + 68.3 = 154.8$ Acres

T_c = Same as above which is equal
to T_c for Drainage Area C-2.

= 15 min.

$I = 4.6$

$Q = (0.50)(4.6)(154.8) = \underline{\underline{356.0 \text{ CFS}}}$

DA - D-3 thru D-8, C-1 & C-2 & B-1

Area = $154.8 + 7.0 = 161.8$ Acres

T_c = Same as above - 15 min. + channel
flow time.

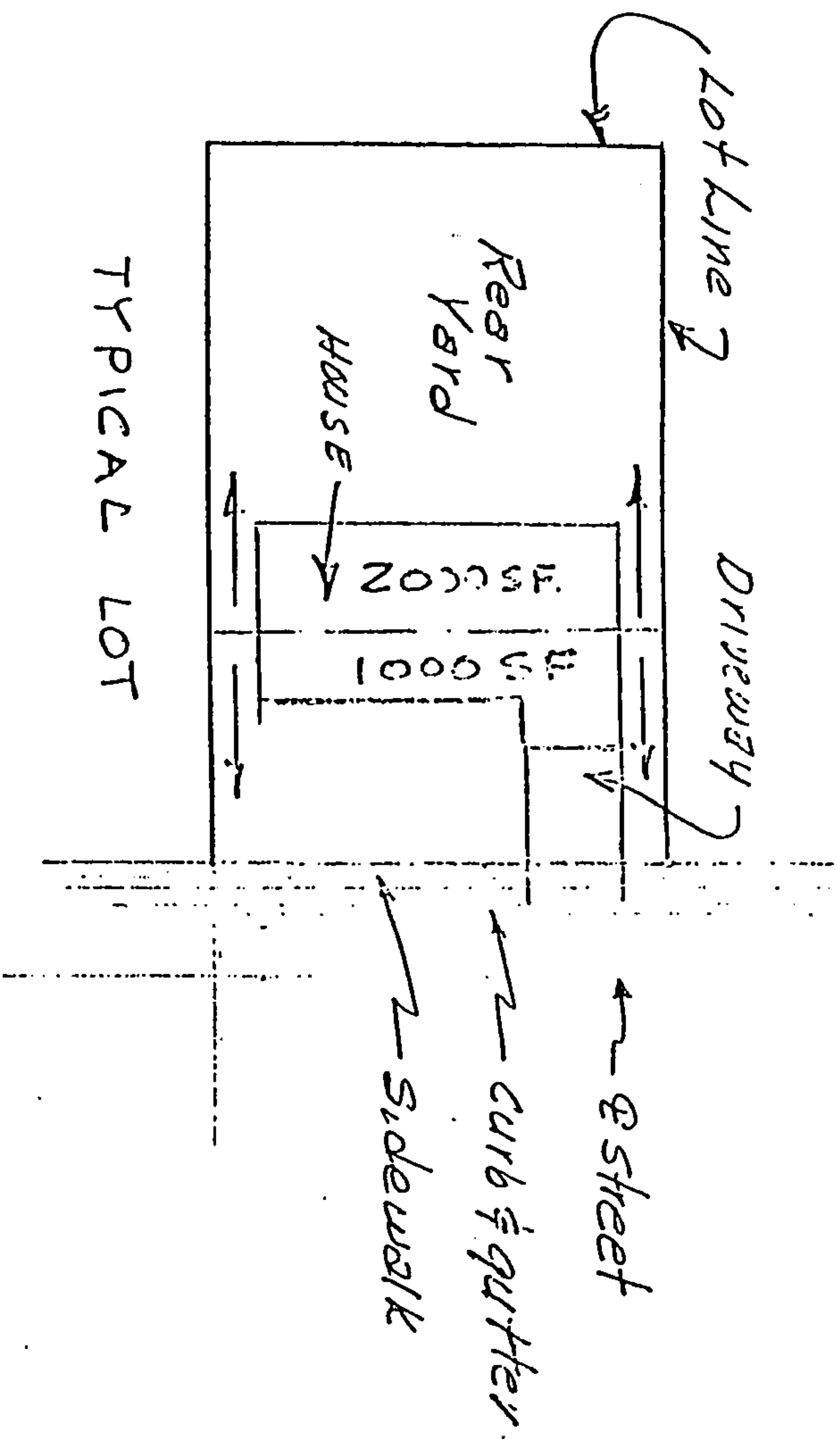
Channel flow time = $700' @ 6 \text{ fps} = 2 \text{ min.}$

$T_c = 15 \text{ min} + 2 \text{ min} = 17 \text{ min.}$

$I = 4.5$

$Q = (0.50)(4.5)(161.8) = \underline{\underline{364.0 \text{ CFS}}}$

DEVELOPED CONDITIONS



Runoff Factors.

Front Yard & Street Area.

$$\begin{aligned} \text{Paved Area} &= 100 \times 16.62 \\ \text{Street} &= 100 \times 4 + 4 \times 25 = 500 \\ \text{Side Walk} &= 20 \times 29.38 \\ \text{Driveway} &= 2750 \end{aligned}$$

Roof Area

Total Hard Surface

$$\begin{aligned} &1000 \\ &3750 \end{aligned}$$

$$\text{Total Area} = 75 \times 100 = 7500 \text{ sq ft}$$

$$\text{Hard Surface} = \frac{3750}{7500} = 50\%$$

$$\text{Land Sloped Area} = 100 - 50 = 50\%$$

$$\begin{aligned} \text{Runoff Factor} &= (0.50)(0.70) + (0.50)(0.40) \\ &= \underline{\underline{0.65}} \end{aligned}$$

Rear Yard

$$\text{Roof Area} = 25 \times 80 = 2000 \text{ ft}^2$$

$$\text{Total Area} = 100 \times 110 = 11,000 \text{ ft}^2$$

$$\text{Hard Surface} = \frac{2000}{11,000} = 13\%$$

$$\text{Land Scaped} = 100 - 13 = 82\%$$

$$\text{Runoff Factor} = (0.13)(0.90) + (0.82)(0.30) \\ = \underline{\underline{0.415}}$$

Ponding Volume

$$V = \text{Rear Yard Area} \times 0.413 \times 3.7' / 12 =$$

$$V = \underline{\underline{\text{Rear Yard Area} \times 0.103 \text{ ft}^3/\text{ft}^2}}$$

NOTE

Due to the steep terrain on which this subdivision is located ponding cannot be accomplished on some lots. However, in considering the total subdivision sufficient ponding shall be provided so as not to increase the volume & rate of runoff due to development.

DEVELOPED CONDITIONS - CONT'D

Following is the drainage analysis of the areas below the diversion ditch.

DRAINAGE AREA C

Flows on Shalako Drive @ Wagontrain.

Area of drainage = 9.8 Acres.

Portion of area having a 0.65 runoff factor = 6.9 Acres - Front yard.

Portion of area having a 0.48 runoff factor = 2.9 Acres - Rear yard.

$T_c < 10$ min. Use $I = 5.4$

$$Q = (0.65)^{24.2} (5.4) (6.9) + (0.48)^{7.5} (5.4) (2.9) = \underline{\underline{31.7 \text{ cfs}}}$$

Flows on La Cebra (Wagontrain) @ Shalako Dr.

Area = 33.5 Acres, $I = 5.4$, $C = 0.50$

$$Q = (0.50) (5.4) (33.5) = \underline{\underline{90.5 \text{ cfs}}}$$

Flows on Wagontrain Drive @ drainage structure of Four Hills Area.

Area = 33.5 Ac - @ $C = 0.5$, 8.6 Ac @ $C = 0.65$
2.9 Ac @ $C = 0.48$ - TOTAL AREA = 45 Acres

$$Q = 5.4 [33.5 \times 0.5 + (8.6 \times 0.65) + (2.9 \times 0.48)] = \underline{\underline{128.1 \text{ cfs}}}$$

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Project FOUR HILLS VILLAGE Sheet 17 of 30
19TH INSTALLMENT Job No. 130
By J:q Chkd ✓ Date 11-28-78

DEVELOPED CONDITIONS - CONT'D

DRAINAGE AREA D

Flows on Ranch Trail @ Camino Cerrito

Area = 3.6 Acres $T_c < 10 \text{ min} - I = 5.4$

$$Q = (0.65)(5.4)(3.6) = \underline{\underline{12.6 \text{ CFS}}}$$

Flows on Camino Cerrito @ Caballero Drive

Portion of area having a runoff factor
of 0.50 = 66.6 Acres

Portion of area having a runoff factor
of 0.65 = 6.1 Acres

Drainage Area is Divided into 2 Reaches

Reach	Length	Elev High Low	Elev. D.H.	T_c
1	900'	6230-5930	300'	4 min.
2	4280'	5930-5804	126'	14 min

TOTAL $T_c = 18 \text{ min.}$

$$I = 4.4$$

$$Q = 4.4 [(0.50 \times 66.6) + (0.65 \times 6.1)] = \underline{\underline{164 \text{ CFS}}}$$

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Project FOUR HILLS VILLAGE Sheet 18 of 30
19TH INSTALLMENT Job No. 130
By Jif Chkd ✓ Date 11-28-78

DRAINAGE AREA D. CONT'D.

Flows on Caballero Drive @ Camino Cerrito

Area = 2.0 Acres I = 5.4

$$Q = (0.65)(5.4)(2) = \underline{\underline{7.0 \text{ CFS}}}$$

TOTAL FLOW @ Intersection of Camino
Cerrito & Caballero Drive

Area = 66.6 Acres @ $C=0.50$ 8.1 Acres @ $C=0.65$

$I = 4.4$ - See previous sheet

$$Q = 4.4 [(0.50 \times 66.6) + (0.65 \times 8.1)] = \underline{\underline{169.7 \text{ CFS}}}$$

Drainage Area E.

Flows on Conestoga Drive Cul de Sac
@ North End.

Area = 2.5 Acres $I = 5.4$

$$Q = (0.65)(5.4)(2.5) = 8.8 \text{ CFS}$$

Flows on Conestoga Drive @ Wagontrain.

Area = 3.0 Acres $I = 5.4$

$$Q = (0.65)(3.0)(5.4) = \underline{\underline{10.5 \text{ CFS}}}$$

Flow on Wagontrain Drive @ West
Boundary & Subdivision.

Area = 4.7 Acres $I = 5.4$

$$Q = (0.65)(5.4)(4.7) = \underline{\underline{16.5 \text{ CFS}}}$$

Flow at Entrance to Four Hills Arroyo
in 17th Installment North of Castellano Rd
& Cotton Avenue Intersection

Area = 29.8 Ac. @ $C = 0.50$, 4.7 Ac. @ $C = 0.65$

Use $I = 5.25$ (See Sheet 4)

$$Q = 5.25 [(0.50 \times 29.8) + (0.65 \times 4.7)] = \underline{\underline{94.3 \text{ CFS}}}$$

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Project FOUR HILLS VILLAGE Sheet 20 of 30
19TH INSTALLMENT Job No. 130
By W.A. CHK'D _____ Date 11-28-78

DEVELOPED CONDITIONS CONT'D

FOUR HILLS ARROYO

Drainage Area A.

Flow @ South Boundary of Subdivision

Area = Drainage Area A Plus Area
diverted by Diversion Ditch.

Area = 603.3 Ac + 161.8 Acres = 765.1 Ac.

I = 3.44 (See Sheet 2)

$$Q = (0.50)(3.44)(765.1) = \underline{\underline{1316 \text{ CFS}}}$$

Flow @ South Side of Wagontrain Dr.

Area = 765.1 + 3.0 = 768.1 Ac.

I = 3.32 (See Sheet 5)

$$Q = (0.50)(3.32)(768.1) = \underline{\underline{1275 \text{ CFS}}}$$

DEVELOPED CONDITIONS - CONT'D

FOUR HILLS AREA

Flows @ Boundary of 19TH Installation
& 17TH Installation.

Area = $768.1 + 2.7 = 770.8 \text{ Ac.} + 45 \text{ Ac.}$ Drainage Area C

Runoff Factor - Drainage Area C = 0.53

$T_c = 33 \text{ min.}$ $I = 3.26$. See Sheet 5

$$Q = 3.26 [(0.50 \times 770.8) + (0.53 \times 45)] = \underline{\underline{1334 \text{ CFS}}}$$

Flows @ Entrance of flow from Drainage
Area D (From Camino Herrito & Laballero Dr.)

Area = 770.8 Ac + Drainage Areas C (45 Ac) & D (74.74 Ac)

Runoff Factor - Drainage Area D = 0.52

$I = 3.26$ - Same as above

$$Q = 3.26 [(0.50 \times 770.8) + (45 \times 0.53) + (74.7 \times 0.52)]$$
$$= \underline{\underline{1461 \text{ CFS}}}$$

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Project FOUR WINDS WELLS Sheet 22 of 30
19th INSTALLMENT Job No. 130
By JH Chkd — Date 11-29-73

Flows @ Bernillo Place SE.

@

$$\text{Area} = 770.8 \text{ Ac} + 8.3 + 2.9 = 782 \text{ CFS}$$

$$\text{Plus Drainage Area } C = 45 \text{ Ac.}$$

$$\text{Drainage Area } D = 74.7 \text{ Ac.}$$

$$\text{Drainage Area } E = 34.5 \text{ Ac.}$$

$$17th \text{ Installment Drainage} = 29.8 \text{ Ac.}$$

$$\text{From } 19th \text{ Installment} = 4.7 \text{ Ac.}$$

$$\text{Runoff Factor} = 0.52 -$$

Use $I. = 3.26$ - Same as above.

$$Q = 3.26 [(0.50 \times 782) + (0.53 \times 45) + (0.52 \times 74.7) + 34.5]$$

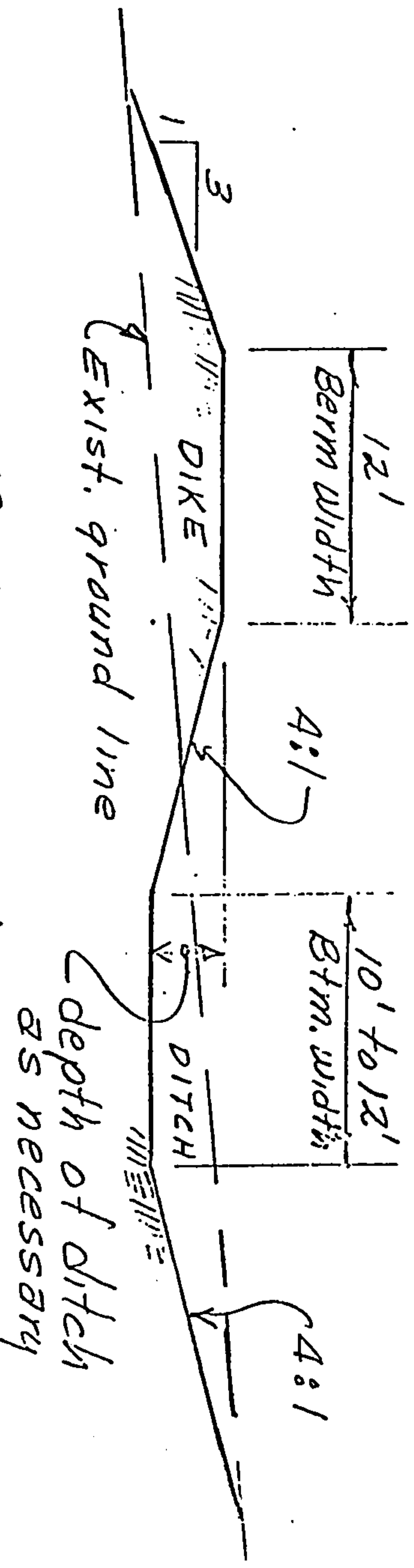
$$Q = \underline{\underline{1538 \text{ CFS}}}$$

FACILITY DESIGN

FOUR HILLS DIVERSION DITCH

Design Concept

1. Earth channel
2. Low velocities - Flat Slope -
3. Provide relatively flat side slopes on ditch to enhance vegetation growth & to minimize erosion.



TYPICAL SECTION

Ditch flows @ various depths - (d)

Use ditch flowline grade of 0.25%

Use $n = 0.030$

$d = 1.0 \text{ ft.}$ 10' bottom width of ditch

$$V = \frac{1.486}{n} R^{2/3} S^{1/2} = \frac{1.486}{0.030} (R^{2/3}) (0.0025)^{1/2}$$

$$V = 49.53 (R)^{2/3} (0.05) \quad R = \frac{A}{wP} = \frac{14}{18.24} R^2$$

$$V = 49.53 (0.84) (0.05) = 2.08 \quad Q = 2.08 \times 14 = \underline{\underline{29.1 \text{ cfs}}}$$

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Project FOUR HILLS WILLOW Sheet 24 of 30
19TH INSTALLMENT Job No. 130
By JH Chkd — Date 11-29-73

FACILITY DESIGN

FOUR HILLS DIVERSION DITCH

TABULATION - DITCH FLOW RATES
Ditch Grade = 0.25%

Ditch Btm. Width	Depth of Flow - FT.	Velocity, FPS	Q, CFS
10'	1.0'	2.08	29.1
10'	1.5'	2.60	62.3
12'	1.0'	2.12	33.9
12'	1.25'	2.40	51.0
12'	1.5'	2.65	71.6
12'	2.0	3.10	124.0
12'	2.5'	3.51	193.0
12'	3.0'	3.88	279.2
12'	3.5'	4.22	384.3
12'	4.0'	4.55	509.5

Ditch Grade = 0.30%

12'	2.5	3.84	211.2
12'	3.0	4.25	306.0
12'	3.5	4.62	420.4

NOTE: Provide desilting basins @ entrance
of larger flow to the diversion ditch.

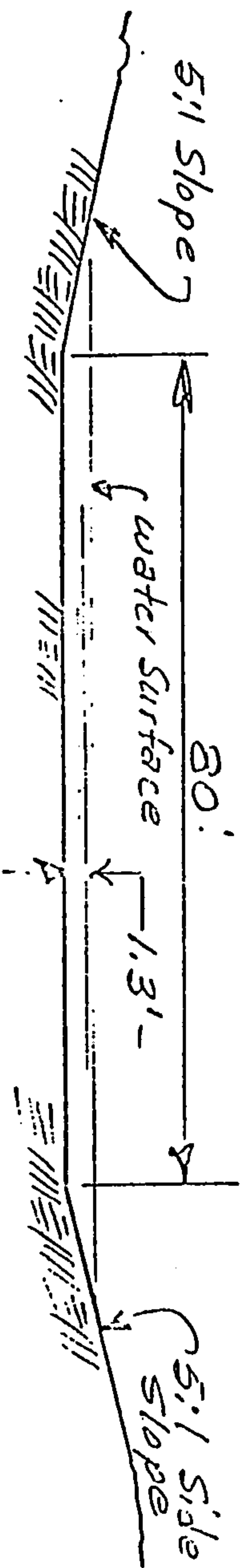
FACILITY DESIGN

FOUR HILLS ARROYO

Existing Arroyo Channel Characteristics

Required Capacity - Upstream of Division.
= 1316 CFS - See Sheet 20

Average width of Channel = 80'
Average Channel side slope = 5:1
Average - Slope of Flowline = 5.3%



Use depth of water = 1.3 ft., $n = 0.030$

$$\text{Area} = 1.3 \times 80 + 1.3 \times 6.5 = 112.5 \text{ ft}^2$$

$$\text{WP} = 93.25' \quad R = \frac{112.5}{93.25} = 1.206$$

$$V = \frac{1.486}{n} R^{2/3} S^{1/2} = \frac{1.486}{0.030} \left(\frac{1.133}{1.206} \right)^{2/3} (0.053)^{1/2}$$

$$V = 12.9 \text{ fps}$$

$$Q = AV = 112.5 \times 12.9 = 1451 \text{ CFS} \quad \text{OK}$$

depth of flow will average
slightly less than 1.3 ft.

NOTES

Provide bank protection @ sides of
arroyo to maintain straight & even flow.

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Project FOUR HILLS WILLOWES Sheet 26 of 30
19TH INSTALLMENT Job No. 150
By JA Chkd U Date 11-29-73

FACILITY DESIGN

FOUR HILLS ARROYO

DRAINAGE STRUCTURE -

Four Hills Arroyo @ Aagontrain Drive

From previous sheet - Channel
entrance velocity = 12.9 cfs

$$\begin{aligned} \text{Required Opening Area of Structure} \\ &= \frac{1316 \text{ cfs}}{12.9} = 102 \text{ ft}^2 \end{aligned}$$

Use 5-60" RCP.

$$\text{open Area} = 2.5^2 \pi \times 5 = 98.17 \text{ ft}^2$$

NOTES

1. Design inlet of structure to increase velocity slightly.
2. Provide channel erosion protection upstream & downstream of structure.

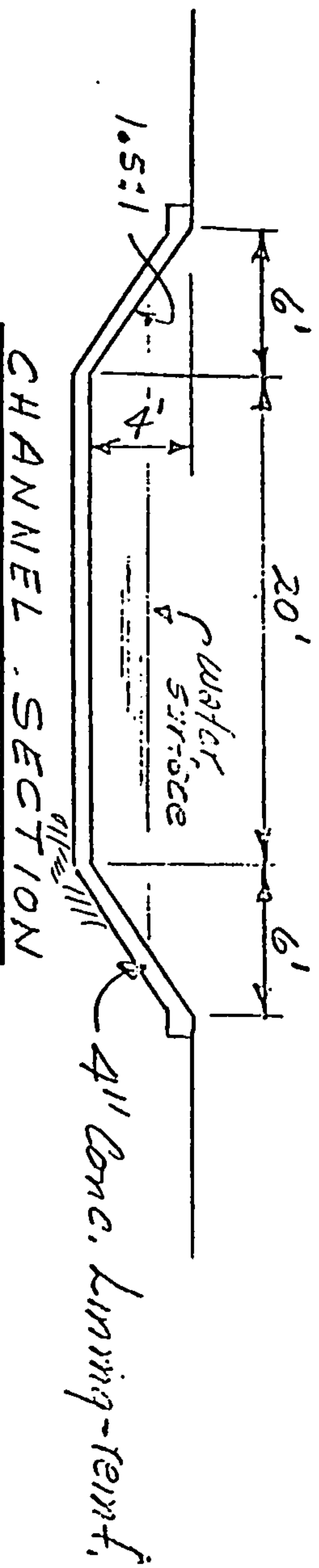
FACILITY DESIGN

FOUR HILLS VILLAGE

Concrete lined Channel

Required Capacity @ Inlet = 1334 CFS
(see Sheet 21)

Design Channel for 1461 CFS - (see Sheet 21)
& for 1538 CFS - (see Sheet 22)



Assume channel slope = 4.20% min.
depth water = 2.2 ft. $n = 0.015$

$$Area = 2.2 \times 20 + 2.2 \times 3.3 = 51.26 ft^2$$

$$WP = 27.93 \quad R = \frac{51.26}{27.93} = 1.835$$

$$V = \frac{1.486}{n} R^{2/3} S^{1/2} = \frac{1.486}{0.015} (1.835)^{2/3} (.042)^{1/2}$$

$$V = 30.44 fps$$

$$Q = AV = 51.26 \times 30.44 = 1560 \text{ CFS} - \text{OK}$$

> 1461 & 1538

NOTES

1. Provide erosion protection @ inlet to conc. lining
2. Provide transition structure @ end of concrete lining & entrance to triple box constructed by City.

FACILITY DESIGN

Camino Cerrito @ Caballero Drive

$Q = 164$ CFS. See Sheet 17

This flow exceeds capacity of existing street.

Solution: Remove existing paving from north boundary of the 19th Installment north to Speakman Drive. Replace with inverted crown street.

Capacity of Inverted Crown street

$n = 0.015$ Slope = 0.60%

Area = $28 \times .17 + 32 \times 0.67 = 26.2 \text{ ft}^2$

$WP = 33.3$

$$R^{2/3} = \left(\frac{26.2}{33.3} \right)^{2/3} = 0.852$$

$$V = \frac{1.486}{0.015} (1.852) (1.006)^{1/2} = 6.54$$

$$Q = 26.2 \times 6.54 = 171.3 \text{ CFS} > 164 \text{ CFS}$$

NOTE

Under high flows in Camino Cerrito there will be some spill over the water block on Speakman Drive as the water block is only 4" high. This will provide some reduction in flow on Camino Cerrito.

ANDREWS, ASBURY & ROBERT, INC.
CONSULTING ENGINEERS
401 San Pedro, NE., Albuquerque, N.M. 87108
Telephone (505) 265-6631

Project FOUR HILLS VILLAGE Sheet 29 of 30
19TH INSTALLMENT Job No. 150
By LL Chkd — Date 11-29-73

FACILITY DESIGN

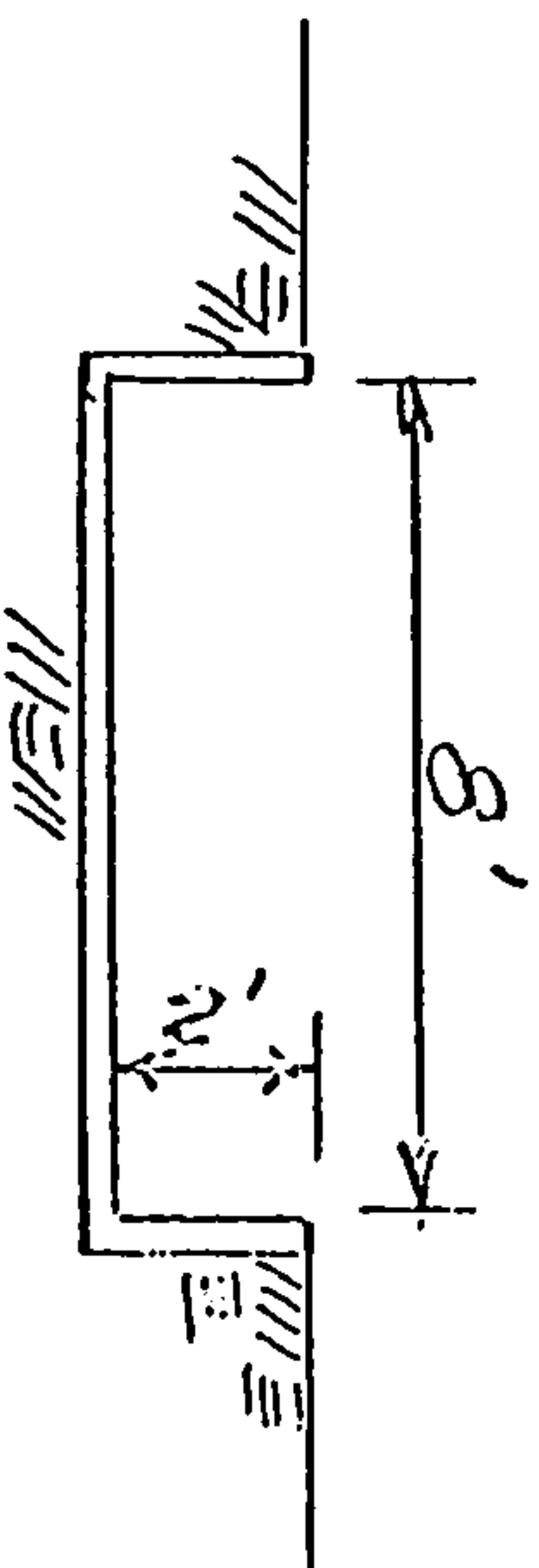
Drainage Easement Channel

Lots 43 & 44 - Block 17-A &

Outlet Channel - Camino Cerro & Caballero Dr.

$$Q = 169.7 \text{ CFS}$$

Use Concrete Channel @ 2% grade



$$\text{depth of flow} = 1.5' \quad n = 0.015$$

$$V = \frac{1.486}{0.015} \times \left(\frac{12}{11}\right)^{2/3} (0.02)^{1/2} = 14.84 \text{ ft/sec}$$

$$Q = AV = (1.5 \times 8) (14.84) = \underline{178 \text{ CFS}} \quad \text{OK}$$

> 169.7

ANDREWS, ASBURY & ROBERT, INC.
CONSULTING ENGINEERS
401 San Pedro, NE., Albuquerque, N.M. 87108
Telephone (505) 265-6631

Project FOUR HILLS WILLOW Sheet 30 of 30
1977 CONCRETE Job No. 130
By JH Chkd ✓ Date 11-29-73

FACILITY DESIGN

Conestoga Drive Cul de Sac.

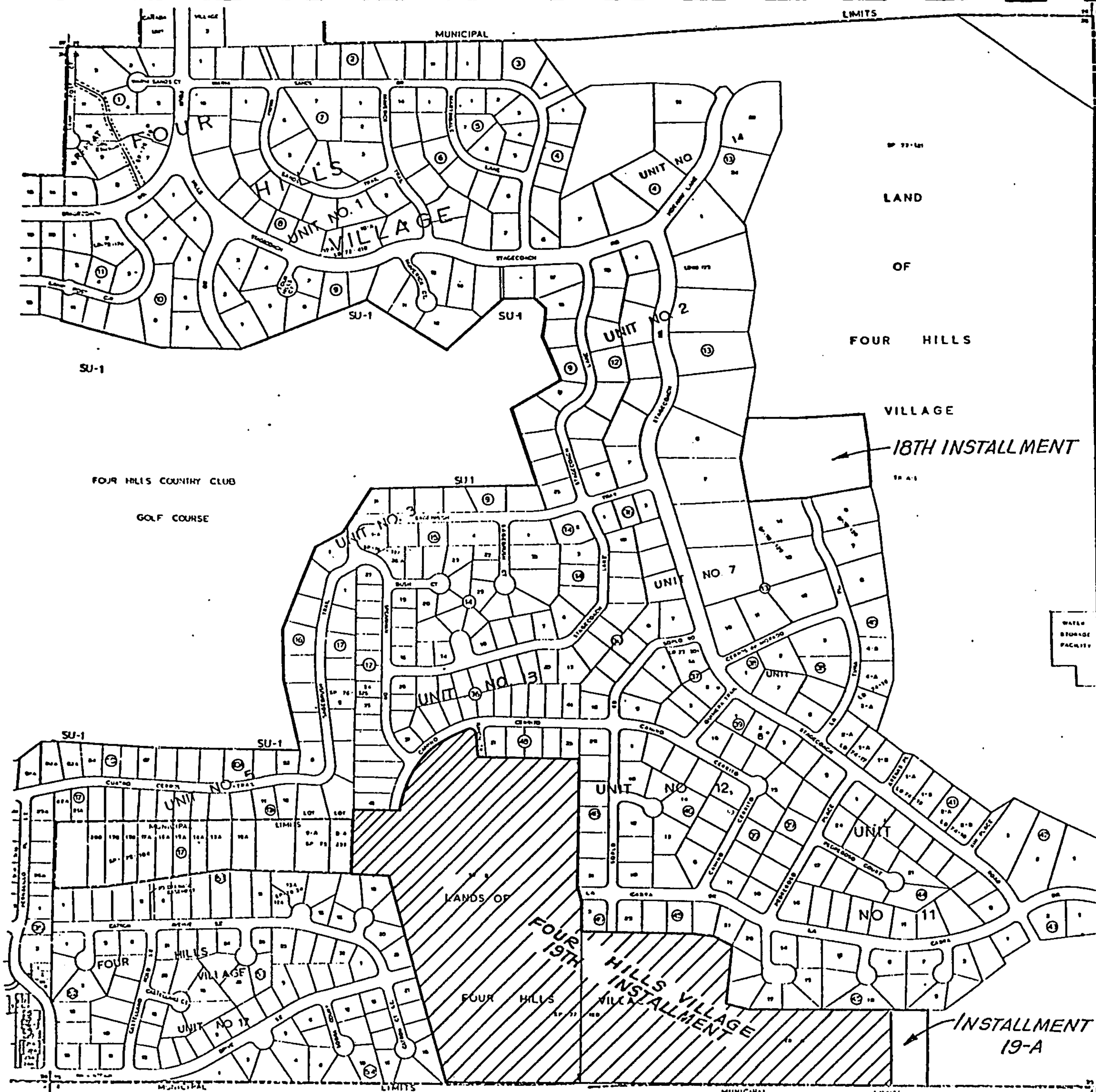
Drainage Easement Storm Sewer
LOTS 39 & 40, Block 54. A

$Q = 8.8 \text{ cfs}$ See Sheet 19

Use - 1- Drop Inlet, Double "C"

Use - 18" RCP outfall line @ 1.6%

Capacity = $\frac{12 \text{ cfs}}{8.8}$ ok



FOUR HILLS VILL. 19TH INSTALLMENT DRAINAGE ANALYSIS

LEGAL DESCRIPTION
T 10 N
R 4 E
SEC 20

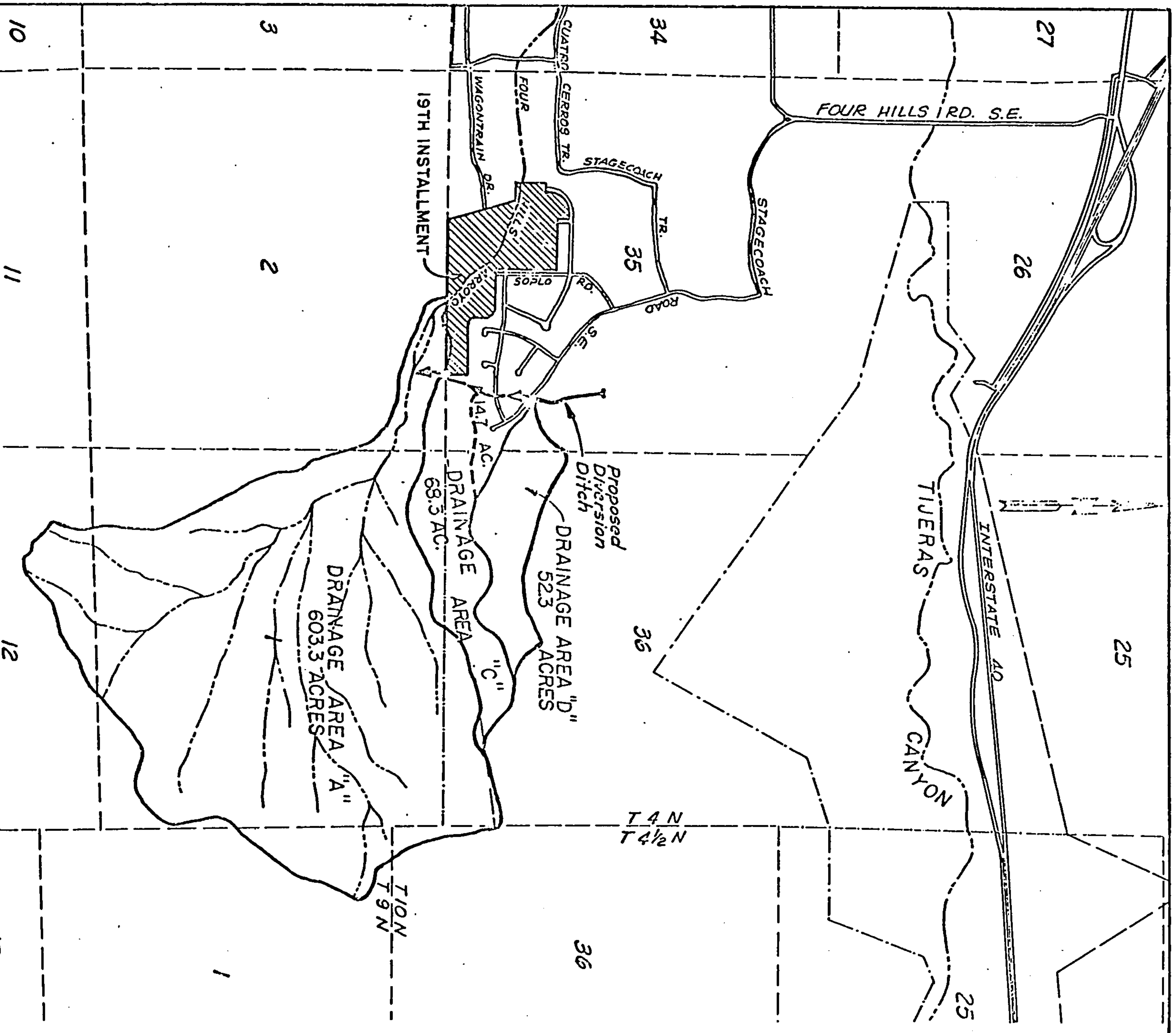
UNIFORM PLANNING CODE
P-001003

MAP AMENDED THROUGH
APRIL 1978

LOCATION MAP

M-23-7

ALBUQUERQUE PLANNING DEPARTMENT



NOTE: SEE MAP NO. 3 &
 MAP NO. 4 FOR
 ONSITE DRAINAGE

FOUR HILLS VILLAGE
 NINETEENTH INSTALLMENT
 DRAINAGE ANALYSIS
 OFFSITE DRAINAGE

SCALE: 1" = 2000'

ANDREWS, ASBURY & ROBERT, INC.
 CONSULTING ENGINEERS
 ALBUQUERQUE, NEW MEXICO

MAP NO. 2

DRAINAGE INFORMATION SHEET

PROJECT TITLE: Ron Johnson Access Road ZONE ATLAS/DRNG. FILE #: M-23-7/2163

DRB #: _____ EPC #: _____ WORK ORDER #: _____

LEGAL DESCRIPTION: Parcel A, Tract A, Lands of Four Hills Village, 11th Install.

CITY ADDRESS: Intersection of Stagecoach and La Cabra S. E.

ENGINEERING FIRM: Ryals Eng & Const. Serv. Co. CONTACT: Robert B. Ryals

ADDRESS: 5301 Central Avenue N. E. #913 PHONE: 256-4701

OWNER: Ron Johnson CONTACT: _____

ADDRESS: 1124 Monte Largo N. E. PHONE: 291-8742

ARCHITECT: _____ CONTACT: _____

ADDRESS: _____ PHONE: _____

SURVEYOR: _____ CONTACT: _____

ADDRESS: _____ PHONE: _____

CONTRACTOR: _____ CONTACT: _____

ADDRESS: _____ PHONE: _____

TYPE OF SUBMITTAL:

☒ DRAINAGE REPORT

☒ DRAINAGE PLAN

☐ CONCEPTUAL GRADING & DRAINAGE PLAN

☒ GRADING PLAN

☐ EROSION CONTROL PLAN

☐ ENGINEER'S CERTIFICATION

☐ OTHER

PRE-DESIGN MEETING:

☒ YES

☐ NO

☐ COPY PROVIDED

CHECK TYPE OF APPROVAL SOUGHT:

☐ SKETCH PLAT APPROVAL

☐ PRELIMINARY PLAT APPROVAL

☐ S. DEV. PLAN FOR SUB'D. APPROVAL

☐ S. DEV. PLAN FOR BLDG. PERMIT APPROVAL

☐ SECTOR PLAN APPROVAL

☐ FINAL PLAT APPROVAL

☐ FOUNDATION PERMIT APPROVAL

☐ BUILDING PERMIT APPROVAL

☒ CERTIFICATE OF OCCUPANCY APPROVAL

☒ GRADING PERMIT APPROVAL

☐ PAVING PERMIT APPROVAL

☐ S.A.D. DRAINAGE REPORT

☐ DRAINAGE REQUIREMENTS

☒ OTHER work order (SPECIFY)

DATE SUBMITTED: 1-5-96 RLJ

BY: _____

JAN - 9

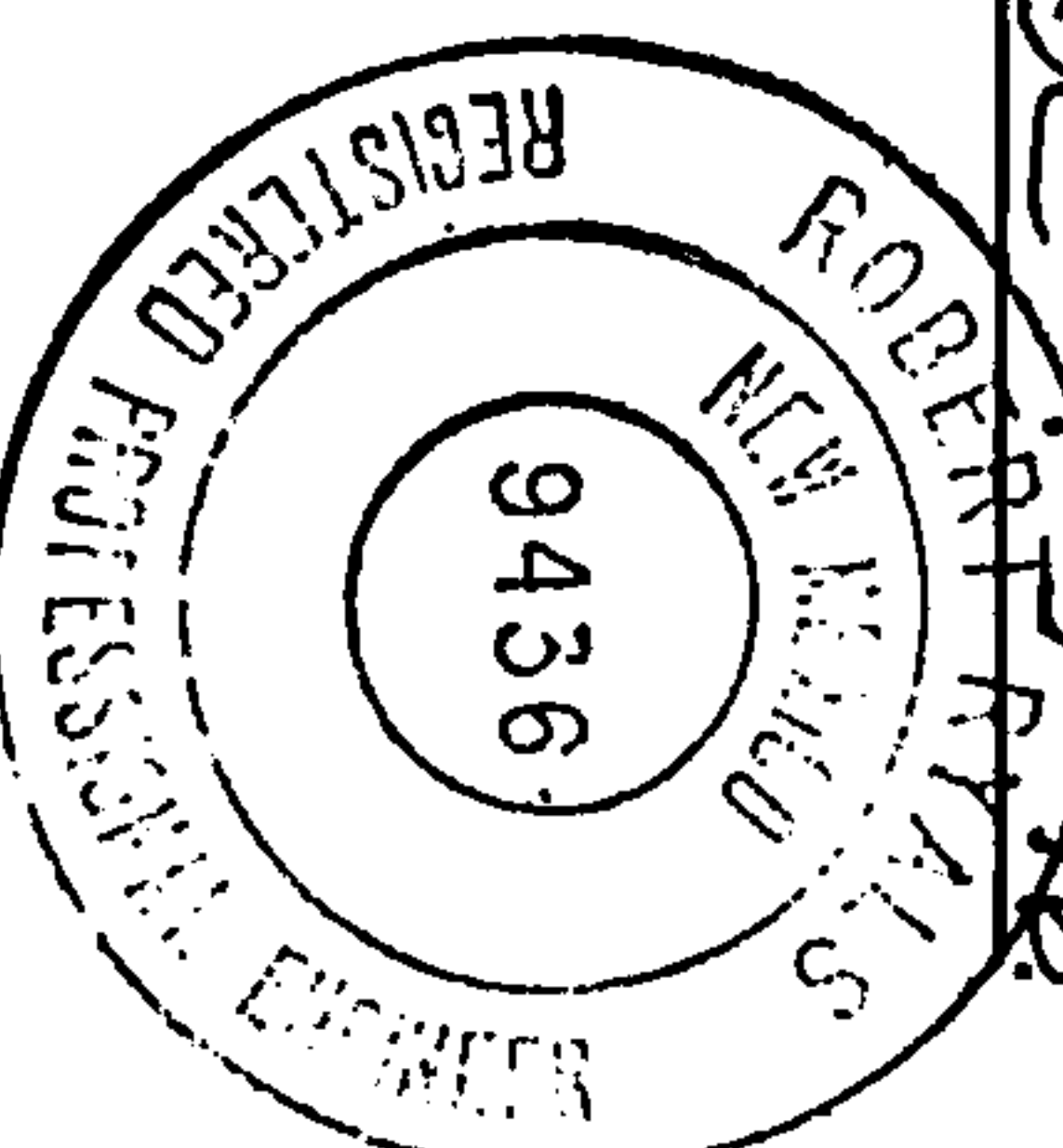
**DRAINAGE REPORT
FOR
RON JOHNSON PRIVATE ACCESS ROAD
FOUR HILLS VILLAGE
CITY OF ALBUQUERQUE**

**Prepared for
Ron Johnson
1124 Monte Largo N. E.
Albuquerque, New Mexico 87123**

**Prepared by
Ryals Engineering and Constructors Services Co.
5301 Central Avenue N. E., Suite #913
Albuquerque, New Mexico 87108**

Robert Ryals, P. E.

Robert Ryals 1-5-96



JAN - 91

TABLE OF CONTENTS

A. DRAINAGE REPORT

1. Introduction
 2. Existing Conditions
 3. Developed Conditions
 4. Recommendations
- Table 1 - Revised Hydrology
- Table 2. - Pipe Culvert Analysis

B. EXHIBITS

1. Study Area Map M-23
2. Paving Plan and Profile Drawing

C. APPENDIX

1. Drainage Report for Four Hills Village 18th
Installment, Dated November 1978
2. Map No. 3 - Four Hills Village 18th Installment
Dated October 1978

**DRAINAGE REPORT
FOR
RON JOHNSON ACCESS ROAD
FOUR HILLS VILLAGES
CITY OF ALBUQUERQUE**

INTRODUCTION

Mr. Ron Johnson proposes building a private access road along a public right-of-way within the 11th Installment of Four Hills Village in the extreme southeast quadrant of the City of Albuquerque (City Zone Map M-23). The proposed road will cross over the Four Hills Diversion Channel at the right-of-way of Stagecoach Road. The road will then follow the La Cabra Drive right-of-way east to the municipal boundary (see Exhibit No. 1). This road is needed to access unplatted property owned by Mr. Johnson.

This report presents the storm drainage analysis that was done to determine the size and quantity of culverts needed to safely pass the 100-year frequency flood flow at the access road crossing at the diversion channel.

EXISTING CONDITIONS

The basis for this report is a drainage report prepared in November 1978 by Andrews, Asbury & Robert, Inc. (AAR) for Paul's Homes, Inc. of Albuquerque. That report is enclosed as Appendix No. 1.

Briefly summarizing the AAR report, Paul's Homes was proposing to develop land for a subdivision within Four Hills Village, 19th Installment. AAR analyzed both onsite and offsite drainage in the vicinity of the proposed subdivision. Offsite drainage included runoff into what was then the proposed Four Hills Diversion Channel. Subbasins D-3 through D-8 delineated in that report form the watershed that generates all the runoff into the diversion channel at the location of the proposed access road crossing.

Subbasins D-3 through D-8 are characterized by soil uncompacted by human activity on slopes of 10-20 percent. These subbasins have remained relatively undisturbed since the AAR report was prepared. Therefore, the hydrologic analysis performed for this study only updates the analysis presented in the report to conform to the current City of Albuquerque, DPM standards (Section 22.2-2, January 1993). Table 1 presents the results of the 100-year flood frequency by subbasin. The total discharge calculated for the 71.8 acre drainage area was 186.7 cfs. The AAR report had calculated a total discharge of 179.5 cfs.

The Four Hills Diversion Channel intercepts major runoff flows east of the Four Hills Village. The channel, which directs the flow in a southerly direction toward the Four Hills Arroyo, is approximately 2,800 feet long and runs from north to south. The western side of the ditch, which protects Four Hills Village, has a berm of 4 feet in height and a top width of 12 to 15 feet. The eastern side does not have a berm. The channel and the land to east side are designated as Open Space.

DEVELOPED CONDITIONS

The proposed method to carry storm water flow at the access road crossing is by using corrugated metal pipe (c.m.p.). To determine the size and quantity of c.m.p. that will be needed, an analysis of existing channel capacity was conducted. Several channel sections up and

downstream of the Stagecoach road right-of-way were surveyed. Typically, these channel sections had side slopes of 3:1, depths of 4 feet from flowline to top of berm, and bottom widths that varied from 12 to 20 feet. The average channel slope was approximately 0.25%. Normal depth calculations were made at several of the cross-sections. Flow was determined to be subcritical with an average normal depth of approximately 2.4 ft. This figure was used as the tailwater depth in the culvert analysis.

A 75-ft. long culvert will be needed to accommodate the roadway width. Several pipe sizes and quantities were looked at that would contain the full 100-year flow. It was determined that two 54" diameter pipes could contain the entire 186.7 cfs. flow without overtopping the crown. Table 2 summarizes the pipe flow analysis for several discharges for a 54" c.m.p.

RECOMMENDATIONS

Since two 54" c.m.p.s will contain the flow, it is recommended that the number pipe be doubled to four in order to double the capacity of the channel so extra freeboard would be not required. The existing berm along the eastern side of the channel will be raised to accommodate the extra height of the culverts. Exhibit No. 2 is the paving plan and profile for the proposed project.

plan sheet?
two pipes
is this road paved?
paved
will be
1-5-94
stamped
M23/D13

TABLE 1.

FILE = RONJON.WQ1
 ALBUQUERQUE, NM, DPM (1/93) CRITERIA - SIMPLE PROCEDURE FOR <= 40 ACRES
 PX100-6 = PRECIPITATION EXCESS FROM 100-YEAR 6-HOUR STORM
 VOL10D = VOLUME OF RUNOFF FROM 100-YEAR 10-DAY STORM
 TRMT CLASS A=UNDISTURBED, B=LAWNS, C=UNPAVED ROADS, D=ROOFS, PAVEMENT
 SEE DPM P 22.5-5

***** PROJECT INFO *****
 RON JOHNSON PROJECT
 CITY OF ALBUQUERQUE
 EXISTING CONDITIONS FROM "DRAINAGE REPORT FOR FOUR HILLS VILLAGE
 19TH INSTALLMENT SITE IMPROVEMENTS (ANDREWS, ASBURY & ROBERT, INC.; NOV,1978)

RAIN ZONE 3 SEE DPM P 22.2-2
 100-YEAR PRECIPITATION (P) DEPTHS, INCHES
 1 HR 6 HR 24 HR 4 DAY 10 DAY
 2.14 2.60 3.10 3.95 4.90

01/08/96 02:21 PM EXISTING CONDITIONS - SUBBASIN D-3							
TRMT CLASS	AREA SQUARE FT.	AREA ACRES	PX100-6 IN/AC	QP100-6 CFS/AC	QP100-6 CFS	VOL6HR AC-FT	
A	0.00	0.0000	0.66	1.87	0.000	0.000	
B	217800.90	5.0000	0.92	2.60	13.000	0.383	
C	0.00	0.0000	1.29	3.45	0.000	0.000	
D	0.00	0.0000	2.36	5.02	0.000	0.000	
TOTAL	217800.90	5.0000			13.000 CU FT	0.383	16698

01/08/96 02:21 PM EXISTING CONDITIONS - SUBBASIN D-4							
TRMT CLASS	AREA SQUARE FT.	AREA ACRES	PX100-6 IN/AC	QP100-6 CFS/AC	QP100-6 CFS	VOL6HR AC-FT	
A	0.00	0.0000	0.66	1.87	0.000	0.000	
B	239581.00	5.5000	0.92	2.60	14.300	0.422	
C	0.00	0.0000	1.29	3.45	0.000	0.000	
D	0.00	0.0000	2.36	5.02	0.000	0.000	
TOTAL	239581.00	5.5000			14.300 CU FT	0.422	18368

01/08/96 02:21 PM EXISTING CONDITIONS - SUBBASIN D-5							
TRMT CLASS	AREA SQUARE FT.	AREA ACRES	PX100-6 IN/AC	QP100-6 CFS/AC	QP100-6 CFS	VOL6HR AC-FT	
A	0.00	0.0000	0.66	1.87	0.000	0.000	
B	82764.30	1.9000	0.92	2.60	4.940	0.146	
C	0.00	0.0000	1.29	3.45	0.000	0.000	
D	0.00	0.0000	2.36	5.02	0.000	0.000	
TOTAL	82764.30	1.9000			4.940 CU FT	0.146	6345

01/08/96 02:21 PM EXISTING CONDITIONS - SUBBASIN D-6							
TRMT CLASS	AREA SQUARE FEI	AREA ACRES	PX100-6 IN/AC	QP100-6 CFS/AC	QP100-6 CFS	VOL6HR AC-FT	
A	0.00	0.0000	0.66	1.87	0.000	0.000	
B	117612.50	2.7000	0.92	2.60	7.020	0.207	
C	0.00	0.0000	1.29	3.45	0.000	0.000	
D	0.00	0.0000	2.36	5.02	0.000	0.000	
TOTAL	117612.50	2.7000			7.020 CU FT	0.207	9017

01/08/96 02:21 PM EXISTING CONDITIONS - SUBBASIN D-7

TRMT	AREA	AREA	PX100-6	QP100-6	QP100-6	VOL6HR
CLASS	SQUARE FEI	ACRES	IN/AC	CFS/AC	CFS	AC-FT
A	0.00	0.0000	0.66	1.87	0.000	0.000
B	191664.80	4.4000	0.92	2.60	11.440	0.337
C	0.00	0.0000	1.29	3.45	0.000	0.000
D	0.00	0.0000	2.36	5.02	0.000	0.000
TOTAL	191664.80	4.4000			11.440	0.337
					CU FT	14694

01/08/96 02:21 PM EXISTING CONDITIONS - SUBBASIN D-8

TRMT	AREA	AREA	PX100-6	QP100-6	QP100-6	VOL6HR
CLASS	SQUARE FEI	ACRES	IN/AC	CFS/AC	CFS	AC-FT
A	0.00	0.0000	0.66	1.87	0.000	0.000
B	2278197.10	52.3002	0.92	2.60	135.981	4.010
C	0.00	0.0000	1.29	3.45	0.000	0.000
D	0.00	0.0000	2.36	5.02	0.000	0.000
TOTAL	2278197.10	52.3002			135.981	4.010
					CU FT	174662

01/08/96 02:21 PM EXISTING CONDITIONS - TOTAL RUNOFF (D-3 THRU D-8)

TRMT	AREA	AREA	PX100-6	QP100-6	QP100-6	VOL6HR
CLASS	SQUARE FEI	ACRES	IN/AC	CFS/AC	CFS	AC-FT
A	0.00	0.0000	0.66	1.87	0.000	0.000
B	3127620.00	71.8003	0.92	2.60	186.681	5.505
C	0.00	0.0000	1.29	3.45	0.000	0.000
D	0.00	0.0000	2.36	5.02	0.000	0.000
TOTAL	3127620.00	71.8003			186.681	5.505
					CU FT	239784

TABLE 2.

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

December 11, 1995
RON JOHNSON PROJECT
CMP CULVERT ANALYSIS
TOTAL Q = 186 CFS. (100-YEAR EVENT)

PROGRAM INPUT DATA:	VALUE
Culvert Diameter (feet).....	4.50
FHWA Chart Number (1,2 or 3).....	2
Scale Number on Chart (Type of Culvert Entrance).....	3
Manning's Roughness Coefficient (n-value).....	0.0240
Entrance Loss-Coefficient of Culvert Opening.....	0.50
Culvert Length (feet).....	75.0
Culvert Slope (feet per foot).....	0.0025

PROGRAM RESULTS:									
Flow Rate (cfs)	Tailwater Depth (ft)	Inlet Control (ft)	Headwater Inlet Control (ft)	Outlet Control (ft)	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
186.7	2.40	10.05	9.53	4.50	3.94	4.50	11.74		
93.4	2.40	4.76	4.86	4.50	2.84	2.84	8.85		
62.2	2.40	3.58	3.82	4.50	2.29	2.40	7.21		
46.7	2.40	2.97	3.39	3.27	1.97	2.40	5.41		
37.3	2.40	2.59	3.16	2.77	1.76	2.40	4.32		
31.1	2.40	2.32	3.01	2.47	1.60	2.40	3.61		

PIPE CULVERT ANALYSIS COMPUTER PROGRAM Version 1.7 Copyright (c)1986
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(713) 895-8322. All Rights Reserved.



LEGAL DESCRIPTION
T 10 N
R 4 E
SEC 20

UNIFORM PROPERTY CODE
1-812-2288

MAP AMENDING TREATY
AUGUST 1991

M-23-Z
CITY OF ALBUQUERQUE
PLANNING DEPARTMENT

CITY OF ALBUQUERQUE
PLANNING DEPARTMENT

APPENDIX

PAUL'S HOMES, INC.
ALBUQUERQUE, NEW MEXICO

DRAINAGE REPORT
FOR
FOUR HILLS VILLAGE
NINETEENTH INSTALLMENT
SITE IMPROVEMENTS

NOVEMBER 1978

ANDREWS, ASBURY & ROBERT, INC.
Consulting Engineers
401 San Pedro, N. E.
Albuquerque, New Mexico 87108
505-265-6631

DRAINAGE REPORT
FOR
FOUR HILLS VILLAGE
NINETEENTH INSTALLMENT
SITE IMPROVEMENTS

TABLE OF CONTENTS

	<u>PAGE</u>
I Introduction	1
II Existing Conditions	2
A. Off site Drainage	2
B. On site Drainage	4
III Developed Conditions	5
A. Four Hills Diversion Ditch	5
B. Four Hills Arroyo	6
C. On site Drainage control	7
IV Lot Ponding Requirements	8
<u>MAPS</u>	
Location Map	Map No. 1
Off site Drainage	Map No. 2
V Design Analysis	11
	Sheets 1 through 30
<u>MAPS</u>	
Existing Conditions	Map No. 3
Developed Conditions	Map No. 4
(See special pocket at back of report for Map No. 3 and Map No. 4)	

I

INTRODUCTION

Paul's Homes, Inc. proposes to improve and develop a 53.7 acre tract of land designated as Four Hills Village, Nineteenth Installment, a subdivision located in the far southeast quadrant of the City of Albuquerque. This subdivision is bounded on the south by lands of Kirtland Air Force Base, on the west by Four Hills Village, Installment Seventeen, and on the north and east by Four Hills Village, Installments Eleven, Twelve and Thirteen. (See enclosed Location Map, Map No. 1, page M-23 of the Zone Atlas.)

The storm drainage analysis included in this drainage report was made to determine the storm water runoff anticipated in the event of a 100-year frequency storm and to provide a plan to control storm water runoff under the proposed developed conditions that will conform to applicable drainage resolutions and ordinances.

In order to provide a comprehensive drainage analysis for the Nineteenth Installment it was necessary to study the surrounding and adjacent platted subdivisions including portions of the 11th, 12th, 13th, 17th and 5th Installments of Four Hills Village. The results of this study are included in this report.

II

EXISTING CONDITIONS

The Four Hills Village, Nineteenth Installment subdivision, consists of ground surfaces relatively broken and steep having grades varying from 4% to 7% and presently undeveloped. However, the area lying directly to the west, north, and along the major portion of the east side is in a developed condition. All adjacent development is in residential use.

The south side of the subdivision is bounded by lands of Kirtland Air Force Base. These lands are completely undeveloped and exist in a natural and native condition.

One of the main drainage features of this subdivision consists of a major arroyo, hereinafter referred to as the Four Hills Arroyo, that bisects the subdivision in a southeasterly-northwesterly direction.

A. OFFSITE DRAINAGE

Offsite areas generating storm water runoff to the subdivision are located northeast, east and southeast of the subdivision site and are shown on Map No. 2 and Map No. 3 enclosed herein.

A runoff factor (c) of 0.50 was chosen for use in

determining the runoff rate from offsite drainage areas. This runoff factor determination was based on site field investigations of the areas. The developed areas have a reasonable amount of built-in rear or side yard ponding and sometimes the front yard, to compensate in the majority of the area for the increased rate of runoff created by the hard surface areas. The developed areas combined with the undeveloped areas that have a fairly open graded soil and good vegetative cover allow the factor as chosen to be considered conservative.

1. FOUR HILLS ARROYO - OFFSITE AREA

The offsite drainage area of the Four Hills Arroyo consists of 603.3 acres and is shown on Map No. 2. Limits of the drainage area were determined from Kirtland Base engineer topographic maps. These maps are at a scale of 1" = 200' with contour intervals of 2 feet and were made available by the Albuquerque Metropolitan Arroyo Flood Control Authority. Prints of such maps are on file at the AMAFCA office.

2. OTHER OFFSITE AREAS

The drainage area limits of the offsite areas other than the Four Hills Arroyo were determined from a combination of methods. Orthophoto topographic mapping at a scale of 1" = 200' was utilized where such mapping was available. The remainder of the area limits was determined from USGS topographic maps at a scale of 1" = 2000' along with field site investigations.

As a result of the study made of the offsite drainage areas it was determined that some existing streets in the Four Hills area are unable to carry the flows generated by a 100-year frequency storm and that some residences in the area are subject to flooding conditions by storms of a much lesser magnitude.

B. ON SITE DRAINAGE

On site drainage under existing conditions is shown on Map No. 2 enclosed herein. The on site drainage north and east of the Four Hills Arroyo is carried to the arroyo by natural drainage channels.

The southwest portion of the subdivision site drains into the 17th Installment street system. The present street system carries the flows west and north to a lined drainage easement channel that empties into the Four Hills Arroyo. (See Map No. 2).

The drainage analysis and computations are included hereinafter in this report.

III

DEVELOPED CONDITIONS

The proposed method of both on site and off site drainage for the subdivision under developed conditions is shown on Map No. 4 enclosed herein.

A. FOUR HILLS DIVERSION DITCH

As shown on Map No. 4 it is proposed to build a diversion ditch approximately 2800 feet in length, herein- after referred to as Four Hills Diversion Ditch, along a north-south alignment and located east of the Four Hills Village area. This diversion ditch will intercept all major runoff flows from the off site drainage areas to the east and direct them southerly to the Four Hills Arroyo.

Permission to construct approximately 300 feet of the diversion ditch on the lands of Kirtland Air Force Base has been formally requested by the City of Albuquerque from the Base Engineer approximately 60 days ago. At the time of this writing an answer has not been received as to whether permission will be granted to extend the outlet of the diversion ditch onto Kirtland Base lands. Indications are that permission will be granted.

An alternate to construction of the outlet of the

diversion ditch on the lands of Kirtland Air Force Base would be the construction of a concrete lined channel along the southerly boundary of the subdivision. Limits of this concrete lined channel would be from the point of intersection of the diversion ditch with the north boundary of Kirtland Base, westerly to the Four Hills Arroyo. (See Map No. 4.)

B. FOUR HILLS ARROYO

As shown on Map No. 4 it is proposed to provide channelization and improvements to the Four Hills Arroyo through the 19th Installment and to the west along the north boundary of the 17th Installment.

Improvements of the arroyo in the 19th Installment include bank protection to confine the flows within the dedicated drainage right-of-way. This bank protection will be provided along the banks of the arroyo between the existing rock outcroppings and will consist of dikes with wire tied rip rap for erosion protection. Other than this bank protection, the arroyo shall be left in its natural state including preservation of the existing vegetation during construction.

Improvements of the arroyo along the north boundary of the 17th Installment consist of constructing a concrete lined channel. Concrete lining of the arroyo along this reach is necessary due to the encroachment of fill into the arroyo

during grading operations performed when developing the 17th
Installation. Limits of the proposed lining are shown on Map
No. 4.

A drainage structure (dry weather crossing) consisting of five (5) 60-inch diameter culvert pipe is proposed to be constructed for the Wagontrain Drive crossing of the arroyo. Erosion protection upstream and downstream of the structure should be provided.

C. ON SITE DRAINAGE CONTROL

Guidelines to be used in controlling storm water runoff when developing the subdivision shall be as follows:

1. Provide for backyard and/or roof ponding as necessary so as not to increase the volume and rate of runoff due to development of the subdivision. Consideration shall be given to the fact that due to the steep terrain on which this subdivision is located, ponding cannot be accomplished on some lots. However, in considering the total area of the subdivision there shall be sufficient total ponding provided so as not to increase runoff due to development of the subdivision.

2. Runoff and ponding determinations shall be made based on the following surfaces or equivalent.

Front yard and street area	
Hard surfaced area	50%
Landscaped area	50%
Back yard area	
Hard surfaced area	18%
Landscaped area	82%

IV

LOT PONDING REQUIREMENTS

Units to be constructed on lots in this subdivision will consist of residential units varying in size from 2000 ft² to 3000 ft².

The basis and factors for determining lot ponding requirements are shown on sheet 15 of the design analysis. From this sheet 15, the volume per square foot of lot area to be ponded is 0.108 ft³.

Following is a tabulation of the lot ponding requirements:

FOUR HILLS VILLAGE 19th INSTALLMENT

LOT PONDING REQUIREMENTS

Block	Lot No.	Storage Volume (CF)
17-A	42	1268
	43	1429
	44	916
	45	1026
	45	1134
	47	1242
	48	1441
	49	2453
	50	838
	51	1613
17-A		
45-A	21	1199
	22	850
	23	1354
	24	1029
	25	1476
	26	-0-
	27	-0-

LOT PONDING REQUIREMENTS (Continued)

Block	Lot No.	Storage Volume (CF)
45-A	28	1134
	29	893
	30	1121
	31	1287
	32	1188
	33	1188
	34	1188
45-A	35	1188
	36	1188
	37	1188
48-A	11	-0-
	12	1381
	13	1460
	14	699
	15	-0-
	16	-0-
	17	1307
48-A	18	1083
	19	1294
	20	-0-
	21	-0-
49-A	3	865
	4	1257
	5	1916
	6	1329
	7	950
	8	950
	9	950
	10	950
	11	975
	12	1107
	13	1892
	14	1772
	15	1188
	16	1188
	17	1188
	18	626
	19	551
	20	-0-
	21	-0-
	22	-0-
	23	-0-
	24	2226

LOT PONDING REQUIREMENTS
(Continued)

Block	Lot No.	Storage Volume (CF)
50-A	2	549
	3	662
	4	954
	5	1001
	6	739
	7	972
	8	972
	9	972
	10	811
	11	1865
	12	1339
50-A	22	731
51-A	23	2129
	24	-0-
	25	-0-
	26	-0-
51-A	27	1755
54-A	22	1026
	23	1080
	24	1080
	25	864
	26	1688
	27	886
	28	799
	29	799
	30	799
	31	799
	32	-0-
	33	3313
54-A	34	1522
	35	1242
	36	2339
	37	-0-
	38	-0-
	39	1970
	40	1487
	41	1459
	42	794
	43	616
	44	-0-
	45	864
54-A	46	864
	47	-0-
	48	-0-
	49	-0-

V

DESIGN ANALYSIS

Included hereinafter are the drainage analyses
(computations) for the subject subdivision. (See sheets
1 through 30).

FOUR HILLS VILLAGE
NINETEENTH INSTALLMENT
SITE IMPROVEMENTS

DRAINAGE ANALYSIS

Sheet

Criteria, Reference Material
and Design Parameters

1

EXISTING CONDITIONS

Drainage Area	A	2
	B	3
	C	3
	D	4
	E	4
Four Hills Arroyo		5

DEVELOPED CONDITIONS

Four Hills Diversion Ditch	8
Individual Areas	8 - 10
Combined Areas	11 - 13
Lot Runoff Factors & Ponding Factors	14 - 15
Drainage Area C	
Street Flows	16
Drainage Area D	
Street & Easement Flows	17 - 18
Drainage Area E	
Street & Easement Flows	19
Four Hills Arroyo	20 - 22

FACILITY DESIGN

Four Hills Diversion Ditch	23 - 24
Four Hills Arroyo	25 - 27
Camino Cerrito	28
Drainage Easement Channel, Lots 43 & 44, Blk 17	29
Conestoga Drive Cul de Sac	30

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Project FOUR HILLS VILLAGE Sheet 1 of 30
19TH INSTALLMENT Job No. 130
By JA Chkd ✓ Date 11-28-78

DRAINAGE ANALYSIS

CRITERIA -

DESIGN STORM - 100 Year Frequency

REFERENCE MATERIAL

1. Albuquerque Area (1961) Intensity Duration - Frequency Curves
2. 100 Year - 6 Hour Precipitation Rainfall Frequency Map for New Mexico - U.S. Weather Bureau. 1967
3. Time of Concentration Nomograph by P.Z. Kirpich.

DESIGN PARAMETERS

Peak Runoff Rate - Rational Formula
 $Q = CIA$

Runoff Volume. $V = \text{Runoff Coefficient} \times \text{Rainfall} \times \text{Area}$

Runoff Coefficients

Offsite & Existing Conditions = 0.50
Hard Surface = 0.90
Landscaped Surface = 0.40

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Project FOUR HILLS VILLAGE Sheet 2 of 30
19 TH INSTALLMENT Job No. 130
By JH Chkd _____ Date 11-28-78

EXISTING CONDITIONS

For offsite drainage Areas - See Map No. 2
and for on site drainage Areas - See Map No. 3.

Drainage Area A -

@ South Boundary of 19th Installment.

Area = 603.3 Acres

To determine (T_c) Time of Concentration
Drainage Area is divided into
four reaches.

<u>Reach</u>	<u>Length</u>	<u>Elev. High. Low</u>	<u>Elev. Diff.</u>	<u>T_c</u>
1	1200'	6580-6400	180'	5 min.
2	1000'	6400-6320	80'	6 "
3	3500'	6320-6080	240'	9 "
4	3700'	6080-5896	184'	10 "
Total T_c =				30 min.

$$I = 3.44, \quad C = 0.50$$

$$Q = (0.50)(3.44)(603.3) = \underline{1038 \text{ CFS}}$$

@ South Bndry of
Subdivision.

EXISTING CONDITIONS. CONT'D

Drainage Area B.

@ Entrance to Four Hills Arroyo -
See map No. 3

Area = 21.1 Acres

Length of Area = 2800'

Elev. Diff = 6028 - 5857 = 171'

$T_c = 11 \text{ min.}$

$I = 5.25$

$$Q = (0.50)(5.25)(21.1) = \underline{\underline{55 \text{ CFS}}}$$

DRAINAGE AREA C.

@ Entrance to Four Hills Arroyo
Near Wagontrain Drive - See map No. 2
and map No. 3.

Area = 117.0 Acres

Drainage Area is divided into 3 reaches

Reach	Length	Elev High - Low.	Elev. Diff	T_c
1	500'	6560 - 6406	160'	3 min
2	4700'	6400 - 5966	434'	12 "
3	2450'	5966 - 5827	139'	.6 "

$$\text{Total } T_c = 21 \text{ min.}$$

$I = 3.9$

$$Q = (0.50)(4.1)(117.0) = \underline{\underline{240 \text{ CFS}}}$$

EXISTING CONDITIONS - CONT'D

DRAINAGE AREA D

@ Entrance to Four Hills Arroyo Southwest
of Camino Cerrito & Caballero Drive,
Area = 154.6 Acres

Drainage Area is divided into 3 reaches.

Reach	Length	Eleu. High	Eleu. Low	Eleu. Diff	Tc
1	4000'	6330	5968	362	12 min.
2	1800'	5968	5346	122	7 min.
3	1700'	5846	5789	57	6 min.

Total Tc = 25 min.

$$I = 3.9$$

$$Q = (0.50)(3.9)(154.6) = \underline{\underline{301 \text{ CFS}}}$$

DRAINAGE AREA E

@ Entrance of drainage channel in
17th Installment North of Caballero Rd &
Cotton Avenue Intersection.

Area = 41.6 Acres

Length Drainage Area = 3870'

Eleu. Diff = 5896 - 5746 = 150' Tc = 11 min.

$$I = 5.25$$

$$Q = (0.50)(5.25)(41.6) = \underline{\underline{109 \text{ CFS}}}$$

EXISTING CONDITIONS CONT'D

FLOW RATES IN FOUR HILLS ARROYO

Combined Drainage Areas A, B, A-1 & A-2

@ Wagontrain Drive

$$\text{Area} = 603.3 + 21.1 + 8.3 + 3.4 = 636.1 \text{ Acres}$$

$$\begin{aligned} T_c \text{ of Area A plus channel flow time} \\ = 30 \text{ min} + 2 \text{ min} = 32 \text{ min.} \end{aligned}$$

$$I = 3.32$$

$$Q = (0.50)(3.32)(636.1) = \underline{\underline{1056 \text{ CFS}}}$$

Combined Drainage Areas

A, B, A-1, A-2, C & A-3

@ Boundary of 19th Installment & 17th Install.

$$\text{Area} = 636.1 + 117.0 + 7.5 = 760.6 \text{ Acres}$$

$$\begin{aligned} T_c = \text{Above } t_c \text{ plus channel flow time} \\ = 32 \text{ min.} + 1 \text{ min} = 33 \text{ min.} \end{aligned}$$

$$I = 3.26$$

$$Q = (0.50)(3.26)(760.6) = \underline{\underline{1240 \text{ CFS}}}$$

EXIST. CONDITIONS - CONT'D -

Combined Drainage Areas

A, B, A-1, A-2, C, A-3 & D

@ entrance of flow from drainage Area D.

$$\text{Area} = 760.6 + 154.6 = 915.2$$

$$T_c = \text{Same as above} = 33 \text{ min} - T = 3.26$$

$$Q = (0.50)(3.26)(915.2) = \underline{\underline{1492 \text{ CFS}}}$$

Combined Drainage Areas -

Same as above plus A-4 & E.

@ Point where flow from 17th Installment enters Four Hills Arroyo

$$\text{Area} = 915.2 + 8.3 + 41.6 = 965.1$$

$$T_c = \text{Above } T_c + \text{Channel Flow time} =$$

$$= 33 \text{ min} + 2 = 35 \text{ min.}$$

$$I = 3.15$$

$$Q = (0.50)(3.15)(965.1) = 1520 \text{ CFS}$$

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Project FOUR HILLS ARROYO Sheet 7 of 30
19TH INSTALLMENT Job No. 130
By JA Ck'd — Date 11-28-78

EXISTING CONDITIONS. CONT'D

Combined Drainage Areas -

Total - A thru E including A-5

Area = 965.1 + 2.9 = 968 - Acres

T_c = Same as above = 35 min.

$I = 3.15$

$Q = (0.50)(3.15)(968) = \underline{\underline{1525 \text{ CFS}}}$

NOTE

See Map No. 3 for Existing Conditions
Flows & Areas,

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Project FOUR HILLS Sheet 8 of 30
19TH INSTALLMENT Job No. 130
By JA. Chkd Date 11-1-75

DEVELOPED CONDITIONS

Following is the drainage analysis for the proposed developed & improved conditions - (See Map No. 4)

FOUR HILLS - DIVERSION DITCH

See MAP NO 4 for designation & location of Drainage Areas.

Drainage Area (DA) D-3

Area = 5.0 Acres

T_c = less than 10 min - Use $I = 5.4$

$C = 0.50$

$Q = CIA = (0.50)(5.4)(5.0) = \underline{\underline{13.5 \text{ cfs}}}$

DA - D-4

Area = 5.5 Ac.

$T_c < 10 \text{ min}$ - Use $I = 5.4$

$Q = (0.50)(5.4)(5.5) = \underline{\underline{14.8 \text{ cfs}}}$

DA - D-5

Area = 1.9 Ac. , $I = 5.4$

$Q = (0.50)(5.4)(1.9) = \underline{\underline{5.1 \text{ cfs}}}$

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Project FOUR HILLS Sheet 9 of 30
19TH INSTALLMENT Job No. 130
By JA Chkd ✓ Date 11-1-78

DIVERSION DITCH - CONT'D

DA - D-6

Area = 2.7 Acres, I = 5.4

$$Q = (0.50)(5.4)(2.7) = \underline{\underline{7.3 \text{ CFS}}}$$

DA - D-7

Area = 4.4 Acres, I = 5.4

$$Q = (0.50)(5.4)(4.4) = \underline{\underline{11.9 \text{ CFS}}}$$

DA - D-8

Area = 52.3 Acres

$$\text{Elev. Diff.} = 6330 - 5968 = 382'$$

$$\text{Length} = 4000'$$

$$T_c = 12 \text{ min.} \quad I = 5.0$$

$$Q = (0.50)(5.0)(52.3) = \underline{\underline{130.8 \text{ CFS}}}$$

DA - C-1

Area = 14.7 Acres, I = 5.4

$$Q = (0.50)(5.4)(14.7) = \underline{\underline{39.7 \text{ CFS}}}$$

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Project 4-HILLS Sheet 10 of 30
19 TH INSTALLMENT Job No. 13
By JA Ckd — Date 11-1-78

DIVERSION DITCH, CONT'D

DA-C-2

Area = 68.3 Acres

Elev. D.F. = Reach 1 - 6560-6400 = 160', 49,500'

Reach 2 - 6400-5966 = 434', 49,4700'

T_c = Reach 1 = 3 min.

Reach 2 = 12 min.

Total = 15 min, $I = 4.6$

$$Q = (0.50)(4.6)(68.3) = \underline{\underline{157.1 \text{ CFS}}}$$

DA-B-1

Area = 7.0 Acres, $I = 5.4$

$$Q = (0.50)(5.4)(7.0) = \underline{\underline{18.9 \text{ CFS}}}$$

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Project FOUR HILLS Sheet 11 of 30
19TH INSTALLMENT Job No. 130
By JA Chkd ✓ Date 11-1-78

DIVERSION DITCH — FLOW ANALYSIS

Flows from Drainage Areas D-3 through D-8, C-1 & C-2 and B-1 will be intercepted by the FOUR HILLS DIVERSION CHANNEL.

DA - D-3 - See Sheet 8

$$Q = \underline{\underline{13.5 \text{ CFS}}}$$

DA - D-3 & D-4

$$\text{Area} = 5.0 + 5.5 = 10.5 \text{ Acres,}$$

$$I = 5.4$$

$$Q = (0.50)(5.4)(10.5) = \underline{\underline{28.4 \text{ CFS}}}$$

DA - D-3, D-4 & D-5

$$\text{Area} = 10.5 + 1.9 = 12.4 \text{ Acres}$$

$$I = 5.4$$

$$Q = (0.50)(5.4)(12.4) = \underline{\underline{33.5 \text{ CFS}}}$$

DA - D-3 thru D-6

$$\text{Area} = 12.4 + 2.7 = 15.1 \text{ Acres}$$

$$T_c < 10 \text{ min. Use } I = 5.4$$

$$Q = (0.50)(5.4)(15.1) = \underline{\underline{40.8 \text{ CFS}}}$$

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Project FOUR HILLS Sheet 12 of 30
19 TH INSTALLMENT Job No. 130
By J.M. Chkd ✓ Date 11-1-73

DIVERSION DITCH CONT'D

DA - D-3 THRU D-7

Area = $15.1 + 4.4 = 19.5$ Acres

$I = 5.4$

$Q = (10.50)(5.4)(19.5) = \underline{\underline{52.6 \text{ CFS}}}$

DA - D-3 THRU D-8

Area = $19.5 + 52.3 = 71.8$ Acres

T_c - Same as for Drainage Area D-8
= 12 min.

$I = 5.0$

$Q = (10.50)(5.0)(71.8) = \underline{\underline{179.5 \text{ CFS}}}$

DA - D-3 THRU D-8 & C-1

Area = $71.8 + 14.7 = 86.5$ Acres

T_c = Same as above - 12 min. + channel
flow time.

Channel flow time = 900' @ 5 fps = 3 min.

$T_c = 12 \text{ min} + 3 \text{ min.} = 15 \text{ min.}$

$I = 4.6$

$Q = (10.5)(4.6)(86.5) = \underline{\underline{199.0 \text{ CFS}}}$

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Project FOUR HILLS Sheet 13 of 30
19TH INSTALLMENT Job No. 130
By JG Chkd ✓ Date 11-1-78

DIVERSION DITCH CONT'D

DA - D-3 thru D-8 & C-1 & C-2.

Area = $86.5 + 68.3 = 154.8$ Acres

T_c = Same as above which is equal
to T_c for Drainage Area e-x.

= 15 min.

$I = 4.6$

$Q = (0.50)(4.6)(154.8) = \underline{\underline{356.0 \text{ CFS}}}$

DA - D-3 thru D-8, C-1 & C-2 & B-1

Area = $154.8 + 7.0 = 161.8$ Acres

T_c = Same as above - 15 min. + channel
flow time.

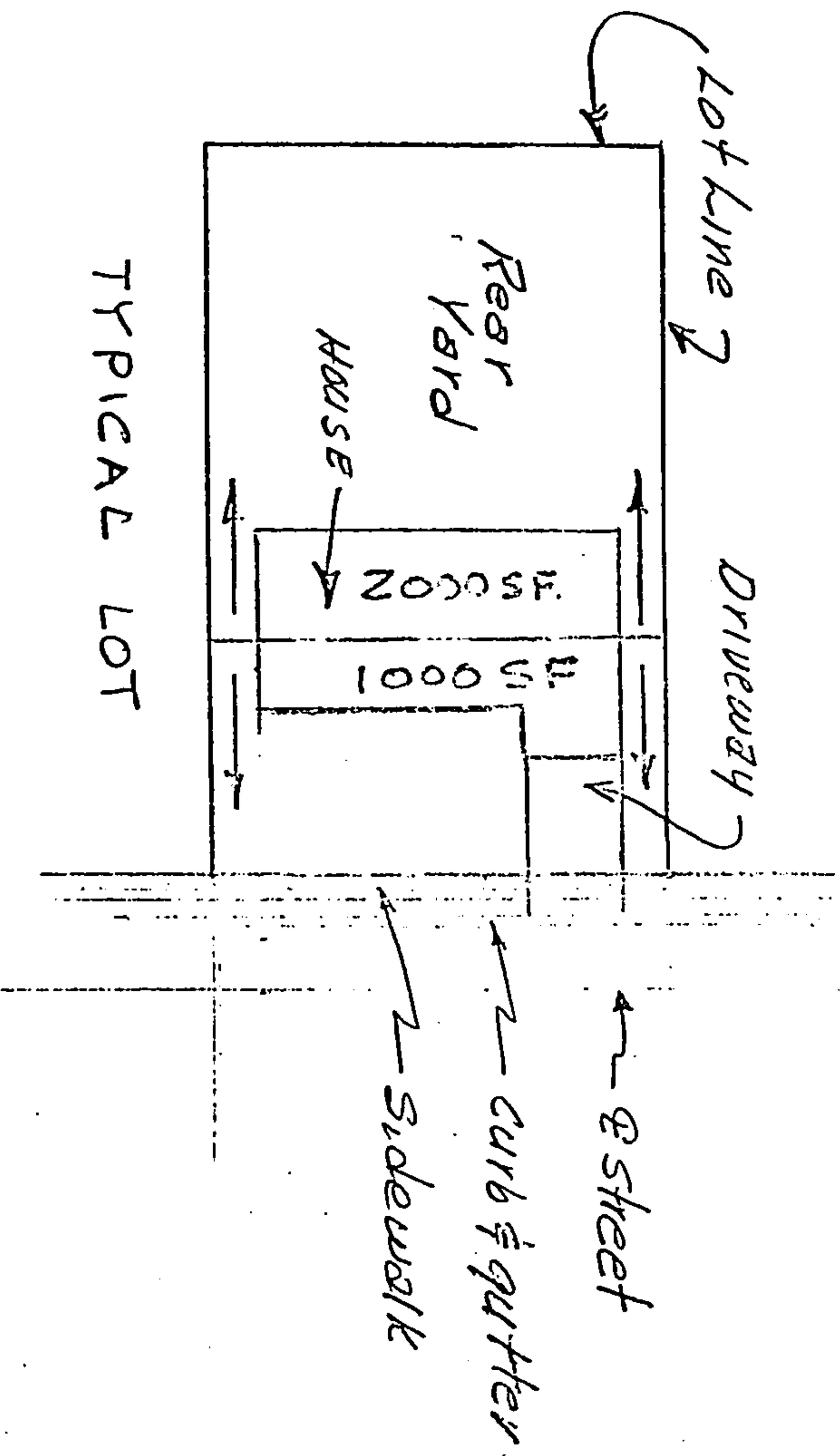
Channel flow time = $700' @ 6 \text{ fps} = 2 \text{ min.}$

$T_c = 15 \text{ min} + 2 \text{ min} = 17 \text{ min.}$

$I = 4.5$

$Q = (0.50)(4.5)(161.8) = \underline{\underline{364.0 \text{ CFS}}}$

DEVELOPED CONDITIONS



Runoff Factors.

Front Yard & Street Area.

Paved Area:		
Street:	100×16.62	1662 ft^2
Side Walk:	$100 \times 4 + 4 \times 25 =$	500
Driveway:	20×29.38	588
		<u>2750 ft^2</u>

Roof Area

Total Hard Surface

$$\text{Total Area} = 75 \times 100 = 7500 \text{ ft}^2$$

$$\text{Hard Surface} = \frac{3750}{7500} = 50\%$$

$$\text{Land Scaped Area} = 100 - 50 = 50\%$$

$$\text{Runoff Factor} = (0.50)(0.70) + (0.50)(0.40) = \underline{\underline{0.65}}$$

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Project FOUR HILLS VILLAGE Sheet 15 of 30
19TH Installation. Job No. 130
By J.A. Chkd _____ Date 11-26-73

Rear Yard

$$\text{Roof Area} = 25 \times 80 = 2000 \text{ ft}^2$$

$$\text{Total Area} = 100 \times 110 = 11,000 \text{ ft}^2$$

$$\text{Hard Surface} = \frac{2000}{11,000} = 18\%$$

$$\text{Land Squared} = 100 - 18 = 82\%$$

$$\text{Runoff Factor} = (0.13)(0.90) + (0.82)(0.45) \\ = \underline{\underline{0.413}}$$

Ponding Volume

$$V = \text{Rear Yard Area} \times 0.413 \times 2.7" / 12 =$$

$$V = \underline{\underline{\text{Rear Yard Area} \times 0.108 \text{ ft}^3/\text{ft}^2}}$$

NOTE

Due to the steep terrain on which this subdivision is located ponding cannot be accomplished on some lots. However, in considering the total subdivision sufficient ponding shall be provided so as not to increase the volume & rate of runoff due to development.

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Project FOUR HILLS WILLAGE Sheet 16 of 30
19TH INSTALLMENT Job No. 130
By JH Chkd L Date 11-28-78

DEVELOPED CONDITIONS - CONT'D

Following is the drainage analysis of the areas below the diversion ditch.

DRAINAGE AREA C

Flows on Sholako Drive @ Wagontrain.

Area of drainage = 9.8 Acres.

Portion of area having a 0.65 runoff factor = 6.9 Acres - front yard.

Portion of area having a 0.48 runoff factor = 2.9 Acres - Rear yard.

$T_c < 10$ min. Use $I = 5.4$

$$Q = (0.65)^{24.2} (5.4) (6.9) + (0.48)^{7.5} (5.4) (2.9) = \underline{\underline{31,700 \text{ cfs}}}$$

Flows on La Cebra (Wagontrain) @ Sholako Dr.

Area = 33.5 Acres, $I = 5.4$, $C = 0.50$

$$Q = (0.50) (5.4) (33.5) = \underline{\underline{90,500 \text{ cfs}}}$$

Flows on Wagontrain Drive @ drainage structure of Four Hills Arroyo

Area = 33.5 Ac @ $C = 0.5$, 8.6 Ac @ $C = 0.65$
2.9 Ac @ $C = 0.48$ - TOTAL AREA = 45 Acres

$$Q = 5.4 [33.5 \times 0.5 + (8.6 \times 0.65) + (2.9 \times 0.48)] = \underline{\underline{128,100 \text{ cfs}}}$$

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Project FOUR HILLS VILLAGE Sheet 17 of 30
19TH INSTALLMENT Job No. 130
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DEVELOPED CONDITIONS - CONT'D

DRAINAGE AREA D

Flows on Ranch Trail @ Camino Cerrito

Area = 3.6 Acres $T_c < 10 \text{ min} - I = 5.4$

$$Q = (0.65)(5.4)(3.6) = \underline{\underline{12.6 \text{ CFS}}}$$

Flows on Camino Cerrito @ Caballero Drive

Portion of area having a runoff factor
of 0.50 = 66.6 Acres

Portion of area having a runoff factor
of 0.65 = 6.1 Acres

Drainage Area is Divided into 2 Reaches

Reach	Length	Elev High Low	Elev. D.H.	T_c
1	900'	6230-5930	300'	4 min.
2	4280'	5930-5804	126'	14 min

TOTAL $T_c = 18 \text{ min.}$

$$I = 4.4$$

$$Q = 4.4 [(0.50 \times 66.6) + (0.65 \times 6.1)] = \underline{\underline{164 \text{ CFS}}}$$

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Project FOUR HILLS VILLAGE Sheet 18 of 30
19TH INSTALLMENT Job No. 130
By JH Chkd — Date 11-28-78

DRAINAGE AREA D. CONT'D.

Flows on Caballero Drive @ Camino Cerrito

Area = 2.0 Acres I = 5.4

$$Q = (0.65)(5.4)(2) = \underline{\underline{7.0 \text{ CFS}}}$$

TOTAL FLOW @ Intersection of Camino
Cerrito & Caballero Drive

Area = 66.6 Acres @ $C=0.50$ 8.1 Acres @ $C=0.65$

$I = 4.4$ - See previous sheet

$$Q = 4.4 [(0.50 \times 66.6) + (0.65 \times 8.1)] = \underline{\underline{169.7 \text{ CFS}}}$$

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Project FOUR HILLS VILLAGE Sheet 19 of 30
19TH INSTALLMENT Job No. 130
By JA Chkd — Date 11-23-78

Drainage Area E.

Flows on Conestoga Drive Cul de Sac
@ North End.

Area = 2.5 Acres $I = 5.4$

$$Q = (0.65)(5.4)(2.5) = 8.8 \text{ CFS}$$

Flows on Conestoga Drive @ Wagontrain.

Area = 3.0 Acres $I = 5.4$

$$Q = (0.65)(5.4)(3.0) = \underline{\underline{10.5 \text{ CFS}}}$$

Flow on Wagontrain Drive @ West
Boundary & Subdivision.

Area = 4.7 Acres $I = 5.4$

$$Q = (0.65)(5.4)(4.7) = \underline{\underline{16.5 \text{ CFS}}}$$

Flow at Entrance to Four Hills Arroyo
19TH INSTALLMENT North of Castellano Rd
& Cotton Avenue Intersection

Area = 29.8 Ac. @ $C = 0.50$, 4.7 Ac. @ $C = 0.65$

Use $I = 5.25$ (See Sheet 4)

$$Q = 5.25[(0.50 \times 29.8) + (0.65 \times 4.7)] = \underline{\underline{94.3 \text{ CFS}}}$$

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Project FOUR HILLS VILLAGE Sheet 20 of 30
19TH INSTALLMENT Job No. 130
By JA Chkd _____ Date 11-23-78

DEVELOPED CONDITIONS CONT'D

FOUR HILLS ARROYO

Drainage Area A.

Flow @ South Boundary of Subdivision

Area = Drainage Area A Plus Area
diverted by Diversion Ditch.

Area = 603.3 Ac + 161.8 Acres = 765.1 Ac.

I = 3.44 (See Sheet 2)

$$Q = (0.50)(3.44)(765.1) = \underline{\underline{1316 \text{ CFS}}}$$

Flow @ South Side of Wagontrain Dr.

Area = 765.1 + 3.0 = 768.1 Ac.

I = 3.32 (See Sheet 5)

$$Q = (0.50)(3.32)(768.1) = \underline{\underline{1275 \text{ CFS}}}$$

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Project FOUR HILLS VILLAGE Sheet 21 of 30
19TH INSTALLMENT Job No. 130
By LH Chkd ✓ Date 11-29-73

DEVELOPED CONDITIONS - CONT'D

FOUR HILLS AREA

Flows @ Boundary of 19TH Installment
& 17TH Installment.

Area = $768.1 + 2.7 = 770.8 \text{ Ac.} + 45 \text{ Ac.}$ Drainage Area C

Runoff Factor - Drainage Area C = 0.53

$T_c = 33 \text{ min.}$ $I = 3.26$. See Sheet 5

$$Q = 3.26 [(0.50 \times 770.8) + (0.53 \times 45)] = \underline{\underline{1334 \text{ CFS}}}$$

Flows @ Entrance of flow from Drainage
Area D (From Camino Territo & Caballero Dr.)

Area = 770.8 Ac + Drainage Areas C (45 Ac.) & D (74.7 Ac.)

Runoff Factor - Drainage Area D = 0.52

$I = 3.26$ - Same as above

$$Q = 3.26 [(0.50 \times 770.8) + (45 \times 0.53) + (74.7 \times 0.52)]$$
$$= \underline{\underline{1461 \text{ CFS}}}$$

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Project FOUR MILES VILLAGE Sheet 22 of 30
17th INSTALLMENT Job No. 130
By JA Chkd — Date 11-29-78

Flows @ Bernalillo Place SE.

@

$$\text{Area} = 770.8 \text{ Ac} + 8.3 + 2.9 = 782 \text{ CFS}$$

Plus Drainage Area $C = 45 \text{ Ac.}$

Drainage Area $D = 74.7 \text{ Ac.}$

Drainage Area $E = 34.5 \text{ Ac.}$

17th Installment Drainage = 29.8 Ac.

From 19th Installment = 4.7 Ac.

Runoff Factor = 0.52 -

Use $I. = 3.26$ - Same as above.

$$Q = 3.26 [(0.50 \times 782) + (0.53 \times 45) + (0.52 \times 74.7) + (0.52 \times 34.5)]$$

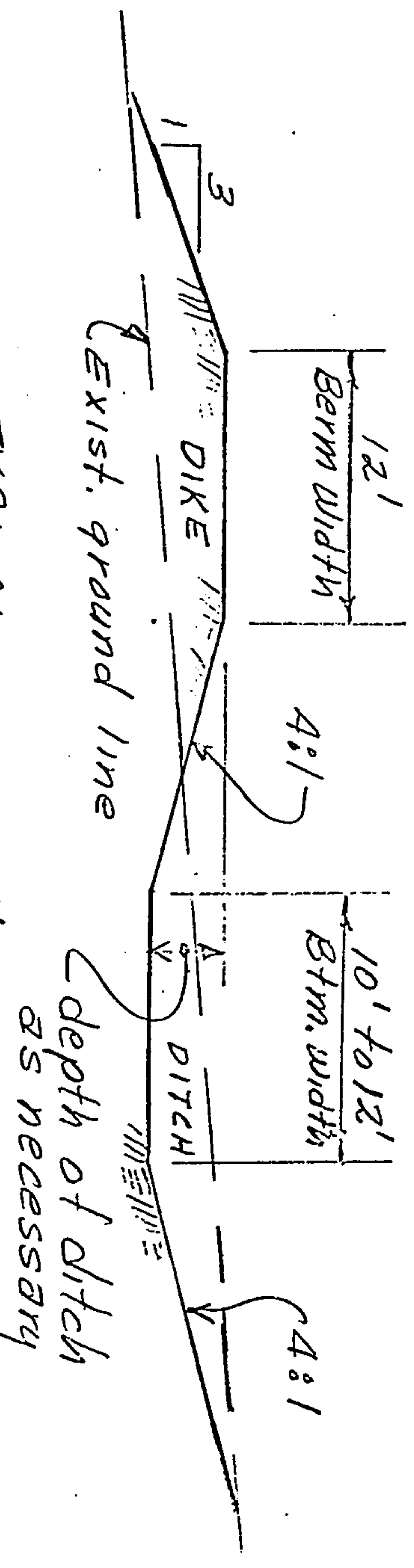
$$Q = \underline{\underline{1538 \text{ CFS}}}$$

FACILITY DESIGN

FOUR HILLS DIVERSION DITCH

Design Concept:

1. Earth channel
2. Low velocities - flat slope -
3. Provide relatively flat side slopes on ditch to enhance vegetation growth & to minimize erosion.



TYPICAL SECTION

Ditch flows @ various depths - (d)

Use ditch flowline grade of 0.25%

Use $n = 0.030$

$d = 1.0 \text{ ft.}$ 10' bottom width of ditch

$$V = \frac{1.486}{n} R^{2/3} S^{1/2} = \frac{1.486}{0.030} (R^{2/3}) (0.0025)^{1/2}$$

$$V = 49.53 (R)^{2/3} (0.05). \quad R = \frac{A}{WP} = \frac{14}{18.24} R^2$$

$$V = 49.53 (0.84) (0.05) = 2.08 \quad Q = 2.08 \times 14 = \underline{29.1 \text{ cfs}}$$

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Project FOUR HILLS VILLAGE Sheet 24 of 30
19TH INSTALLMENT Job No. 130
By JH Chkd — Date 11-29-78

FACILITY DESIGN

FOUR HILLS DIVERSION DITCH

TABULATION - DITCH FLOW RATES
Ditch Grade = 0.25%

Ditch Estm. width	Depth of flow - FT.	Velocity FPS	Q CFS
10'	1.0'	2.08	29.1
10'	1.5'	2.60	62.3
12'	1.0'	2.12	33.9
12'	1.25'	2.40	51.0
12'	1.5'	2.65	71.6
12'	2.0	3.10	124.0
12'	2.5'	3.51	193.0
12'	3.0'	3.88	279.2
12'	3.5'	4.22	384.3
12'	4.0'	4.55	509.5

Ditch Grade = 0.30%

12'	2.5	3.84	211.2
12'	3.0	4.25	306.0
12'	3.5	4.62	420.4

NOTE: Provide desilting basins @ entrance
of larger flow to the diversion ditch.

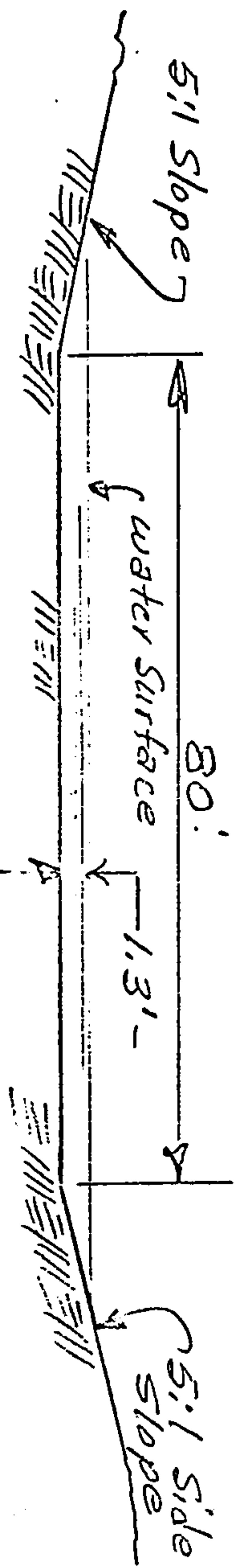
FACILITY DESIGN

FOUR HILLS ARROYO

Existing Arroyo Channel Characteristics

Required Capacity - Upstream of Wagon Train.
= 1316 CFS - See Sheet 20

Average width of Channel = 80'
Average Channel Side Slope = 5:1
Average Slope of Flowline = 5.3%



Use depth of water = 1.3 ft., $n = 0.030$

$$\text{Area} = 1.3 \times 80 + 1.3 \times 6.5 = 112.5 \text{ ft}^2$$

$$WP = 93.25' \quad R = \frac{112.5}{93.25} = 1.206$$

$$V = \frac{1.486}{n} R^{2/3} S^{1/2} = \frac{1.486}{0.030} (1.133)^{2/3} (1.053)^{1/2}$$

$$V = 12.9 \text{ fps}$$

$$Q = AV = 112.5 \times 12.9 = 1451 \text{ CFS} \quad \text{OK}$$

depth of flow will average
slightly less than 1.3 ft.

NOTES

Provide bank protection @ sides of
arroyo to maintain straight & even flow.

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Project FOUR HILLS WILLMSE Sheet 26 of 30
19TH INSTALLMENT Job No. 130
By JA Chkd U Date 11-29-78

FACILITY DESIGN

FOUR HILLS ARROYO

DRAINAGE STRUCTURE -

Four Hills Arroyo @ Lagartan Drive

From previous sheet - Channel
entrance velocity = 12.9 cfs

$$\begin{aligned} \text{Required Opening Area of Structure} \\ &= \frac{1316 \text{ cfs}}{12.9} = 102 \text{ ft}^2 \end{aligned}$$

Use 5-60" RCP.

$$\text{Open Area} = 2.5^2 \pi \times 5 = 98.17 \text{ ft}^2$$

NOTES

1. Design inlet of structure to increase velocity slightly.
2. Provide channel erosion protection upstream & downstream of structure.

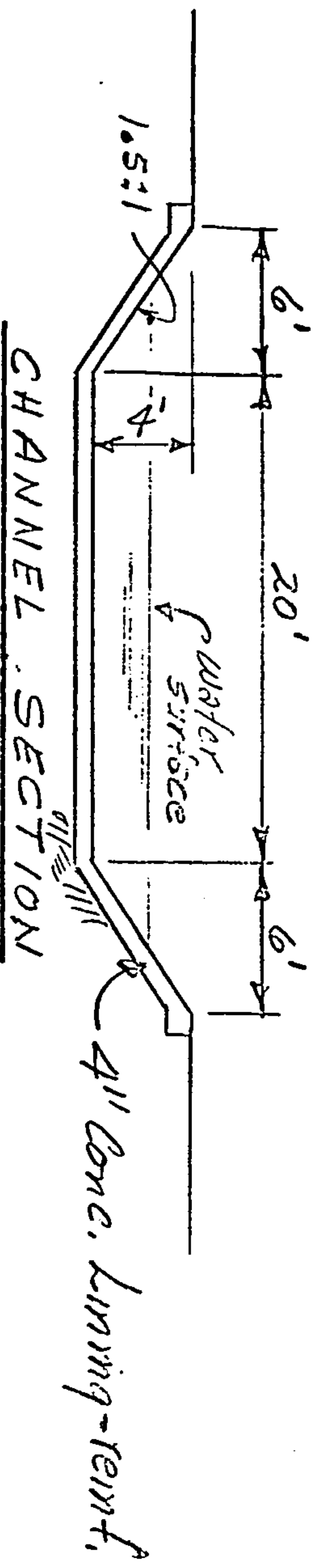
FACILITY DESIGN

FOUR HILLS WRRD#10

Concrete lined Channel

Required Capacity @ Inlet = 1334 CFS
(see sheet 21)

Design channel for 1461 CFS - (see sheet 21)
\$ for 1538 CFS - (see sheet 22)



Assume channel slope = 4.20% min.

depth water = 2.2 ft. $n = 0.015$

$$Area = 2.2 \times 20 + 2.2 \times 3.3 = 51.26 ft^2$$

$$WP = 27.93 \quad R = \frac{51.26}{27.93} = 1.835$$

$$V = \frac{1.486}{n} R^{2/3} S^{1/2} = \frac{1.486}{0.015} (1.835)^{2/3} (.042)^{1/2}$$

$$V = 30.44 fps$$

$$Q = AV = 51.26 \times 30.44 = 1560 \text{ CFS} - \text{OK}$$

> 1461 & 1538

NOTES

1. Provide erosion protection @ inlet to conc. lining
2. Provide transition structure @ end of concrete lining & entrance to triple box constructed by city.

FACILITY DESIGN

Camino Cerrito @ Caballero Drive

$Q = 164$ CFS. See Sheet 17

This flow exceeds capacity of existing street.

Solution: Remove existing paving from north boundary of the 19th Installment north to Speakman Drive. Replace with inverted crown street.

Capacity of Inverted Crown Street

$n = 0.015$ Slope = 0.60%

Area = $28 \times 17 + 32 \times 0.67 = 26.2 \text{ ft}^2$

$WP = 33.3$

$R^{2/3} = \left(\frac{26.2}{33.3} \right)^{2/3} = 0.852$

$V = \frac{1.486}{0.015} (1.852) (1.006)^{1/2} = 6.54$

$Q = 26.2 \times 6.54 = 171.3$ CFS > 164 CFS

NOTE

Under high flows in Camino Cerrito there will be some spill over the water block on Speakman Drive as the water block is only 4" high. This will provide some reduction in flow on Camino Cerrito.

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Project FOUR HILLS VILLAGE Sheet 29 of 30
19TH INSTALLMENT Job No. 130
By L.H. Chkd — Date 11-29-73

FACILITY DESIGN

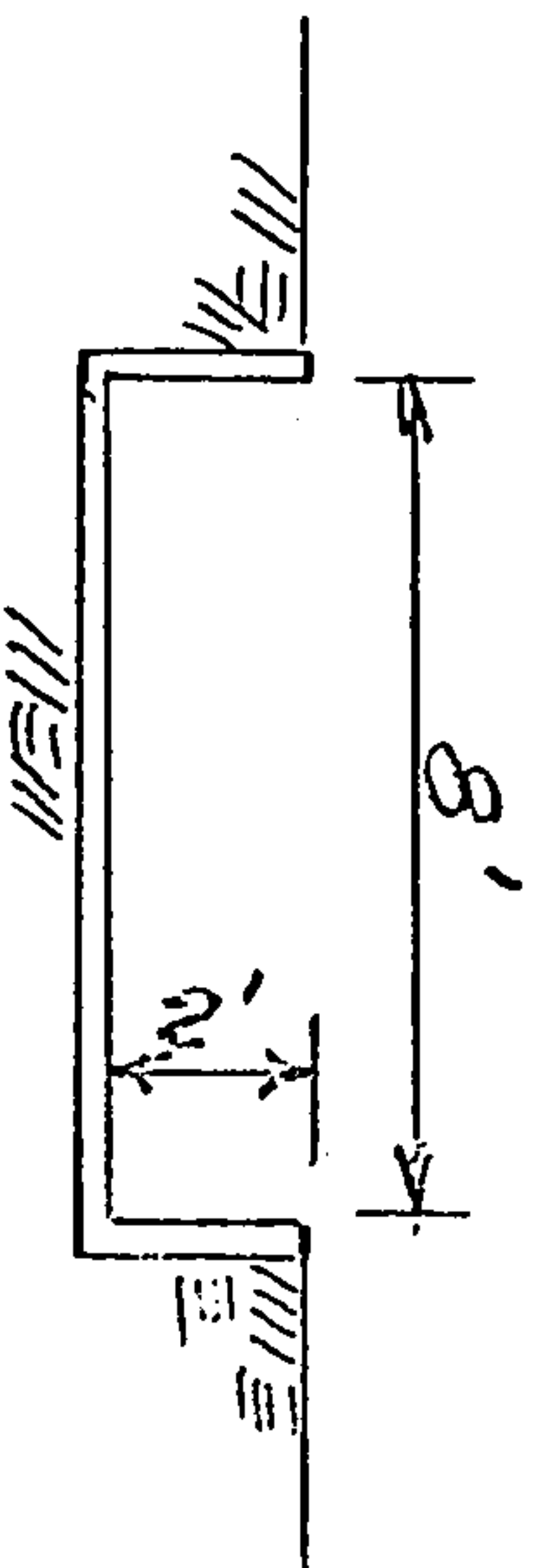
Drainage easement Channel

Lots 43 & 44 - Block 17-A &

Outlet Channel - Camino Cerrito & Caballero Dr.

$$Q = 169.7 \text{ CFS}$$

Use concrete Channel @ 2% grade



$$\text{depth of flow} = 1.5' \quad n = 0.015$$

$$V = \frac{1.486}{0.015} \times \left(\frac{12}{11}\right)^{2/3} (0.02)^{1/2} = 14.84 \text{ ft/sec}$$

$$Q = AV = (1.5 \times 8) (14.84) = \underline{178 \text{ CFS}} \quad \text{OK}$$

> 169.7

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Project FOUR HILLS VILLAGE Sheet 30 of 30
1977 EASEMENT Job No. 130
By JA Chkd ✓ Date 11-29-73

FACILITY DESIGN

Conestoga Drive Cul de Sac.

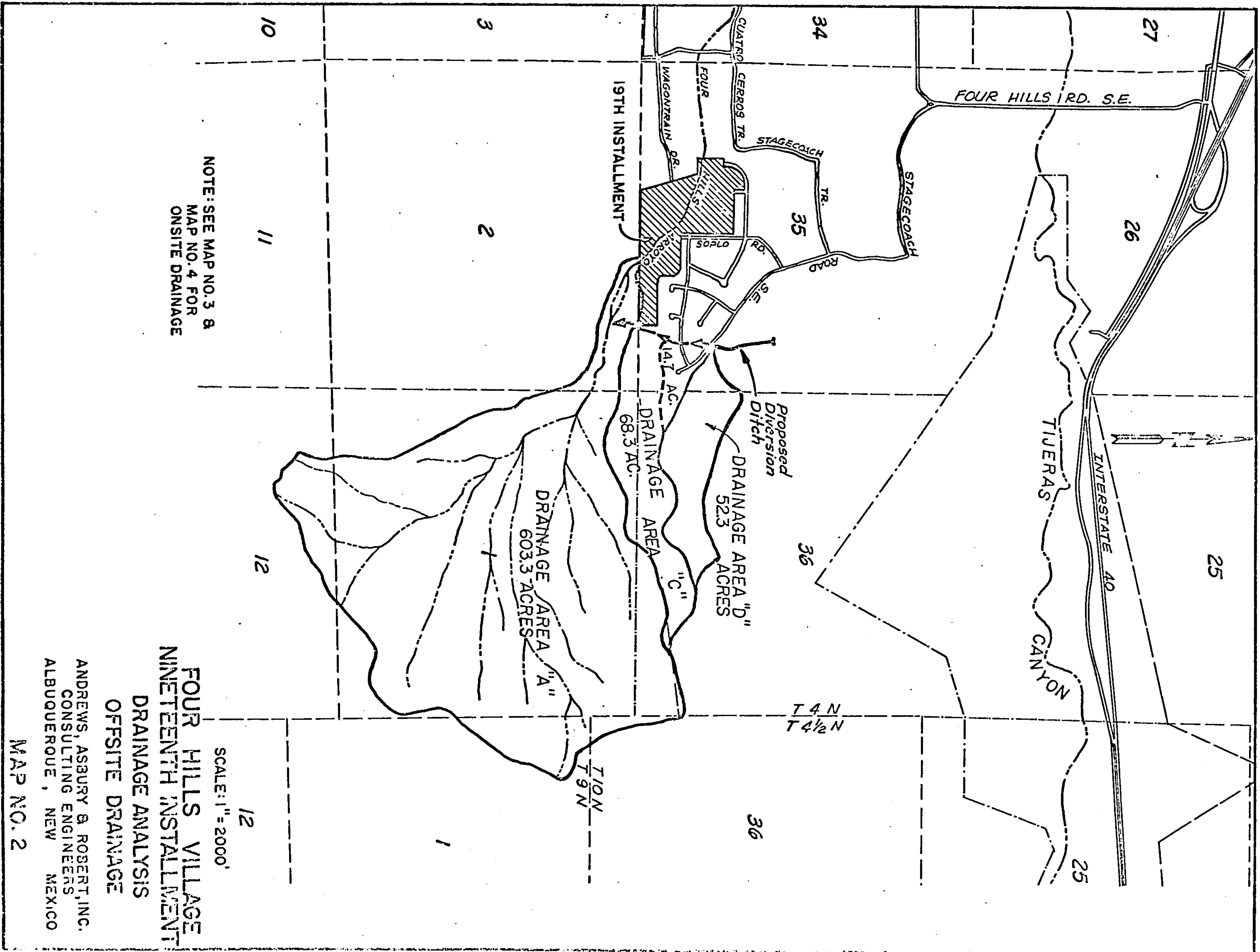
Drainage Easement Storm Sewer
LOTS 39 & 40, Block 54. A

Q = 8.8 cfs See Sheet 19

Use - 1- Drop Inlet, Double "C"

Use - 18" RCP outfall line @ 1.6%

Capacity = 12 cfs ok
> 8.8



DRAINAGE INFORMATION SHEET

1423/1/3

PROJECT TITLE: Ron Johnson Access Road ZONE ATLAS/DRNG. FILE #: ~~1423-2~~

DRB #: _____ EPC #: _____ WORK ORDER #: _____

LEGAL DESCRIPTION: Parcel A, Tract A, Lands of Four Hills Village, 11th InstallCITY ADDRESS: Intersection of Stagecoach and La Cabra S. E.ENGINEERING FIRM: Ryals Eng & Const. Serv. Co. CONTACT: Robert B. RyalsADDRESS: 5301 Central Avenue N. E. #913 PHONE: 256-4701OWNER: Ron Johnson CONTACT: _____ADDRESS: 1124 Monte Largo N. E. PHONE: 291-8742

ARCHITECT: _____ CONTACT: _____

ADDRESS: _____ PHONE: _____

SURVEYOR: _____ CONTACT: _____

ADDRESS: _____ PHONE: _____

CONTRACTOR: _____ CONTACT: _____

ADDRESS: _____ PHONE: _____

TYPE OF SUBMITTAL:

☒ DRAINAGE REPORT☐ DRAINAGE PLAN☐ CONCEPTUAL GRADING & DRAINAGE PLAN☒ GRADING PLAN☐ EROSION CONTROL PLAN☐ ENGINEER'S CERTIFICATION☐ OTHER _____

CHECK TYPE OF APPROVAL SOUGHT:

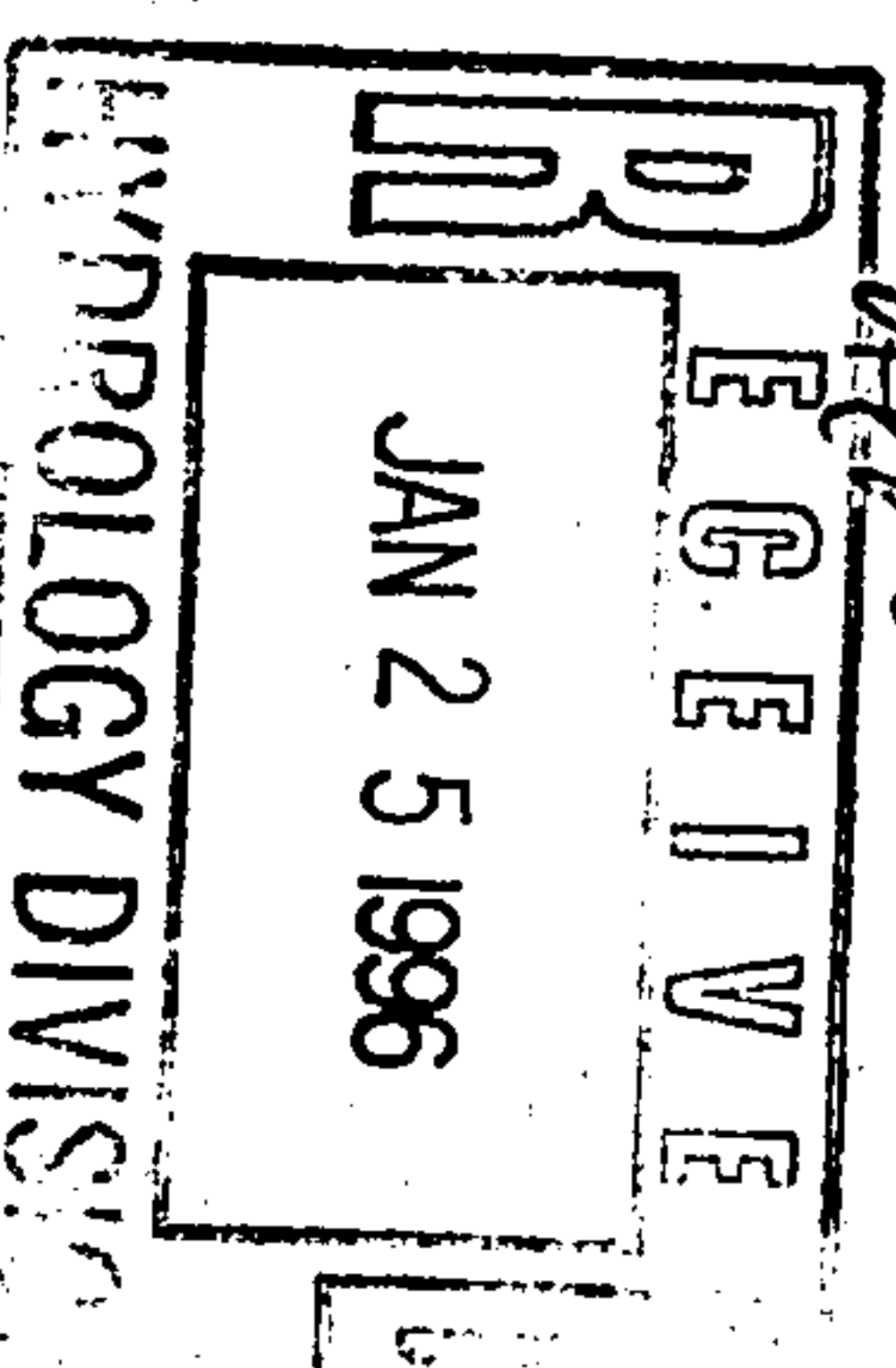
☐ SKETCH PLAT APPROVAL☐ PRELIMINARY PLAT APPROVAL☐ S. DEV. PLAN FOR SUB'D. APPROVAL☐ S. DEV. PLAN FOR BLDG. PERMIT APPROVAL☐ SECTOR PLAN APPROVAL☒ FINAL PLAT APPROVAL☐ FOUNDATION PERMIT APPROVAL☐ BUILDING PERMIT APPROVAL☒ CERTIFICATE OF OCCUPANCY APPROVAL☒ GRADING PERMIT APPROVAL☐ PAVING PERMIT APPROVAL☐ S.A.D. DRAINAGE REPORT☐ DRAINAGE REQUIREMENTS☒ OTHER work order (SPECIFY)

PRE-DESIGN MEETING:

☒ YES☐ NO☐ COPY PROVIDED

DATE SUBMITTED: _____

BY: _____



**DRAINAGE REPORT
FOR
RON JOHNSON PRIVATE ACCESS ROAD
FOUR HILLS VILLAGE
CITY OF ALBUQUERQUE**

Prepared for
Ron Johnson
1124 Monte Largo N. E.
Albuquerque, New Mexico 87123

Prepared by
Ryals Engineering and Constructors Services Co.
5301 Central Avenue N. E., Suite #913
Albuquerque, New Mexico 87108

Robert Ryals, P. E.

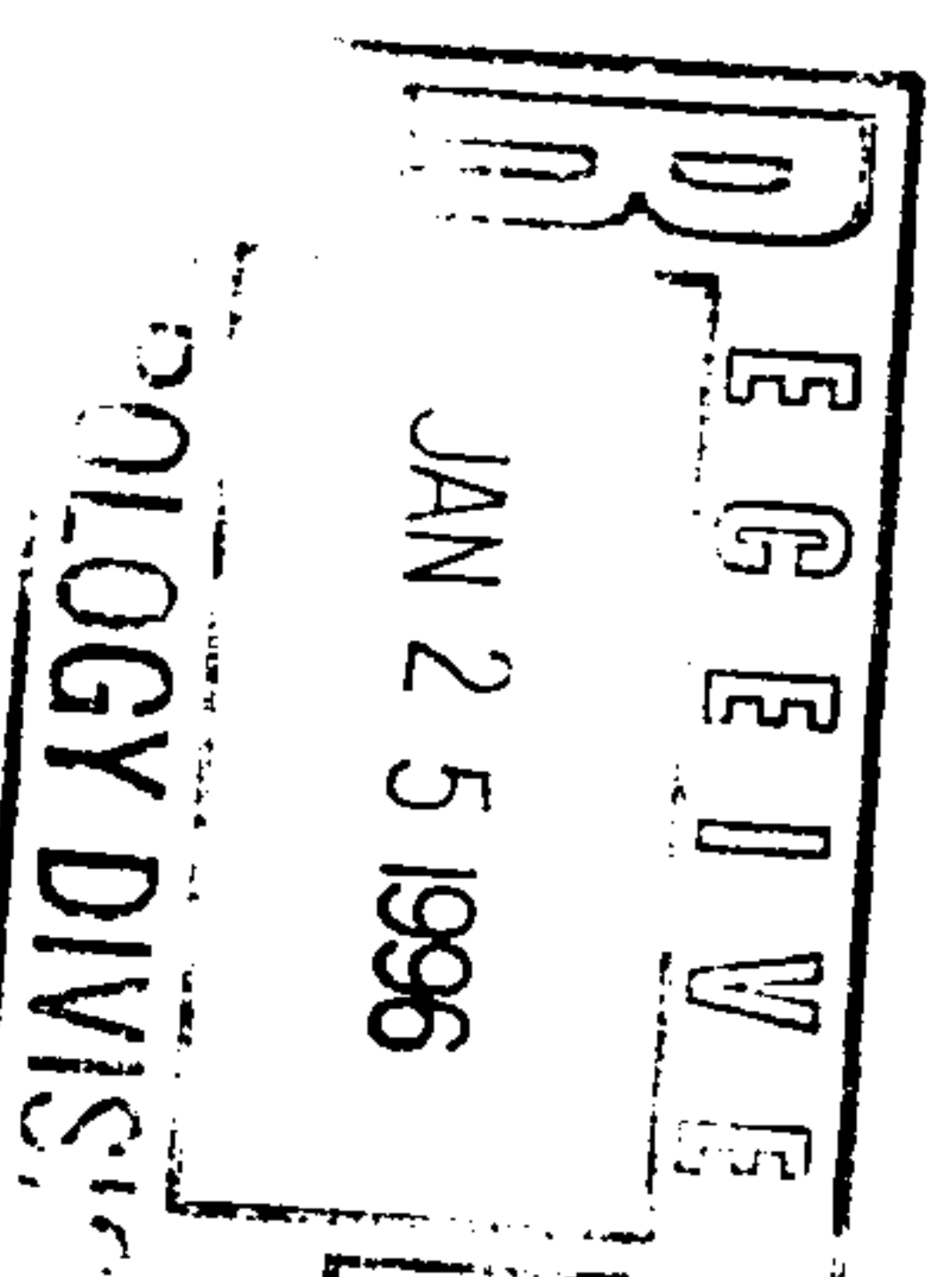
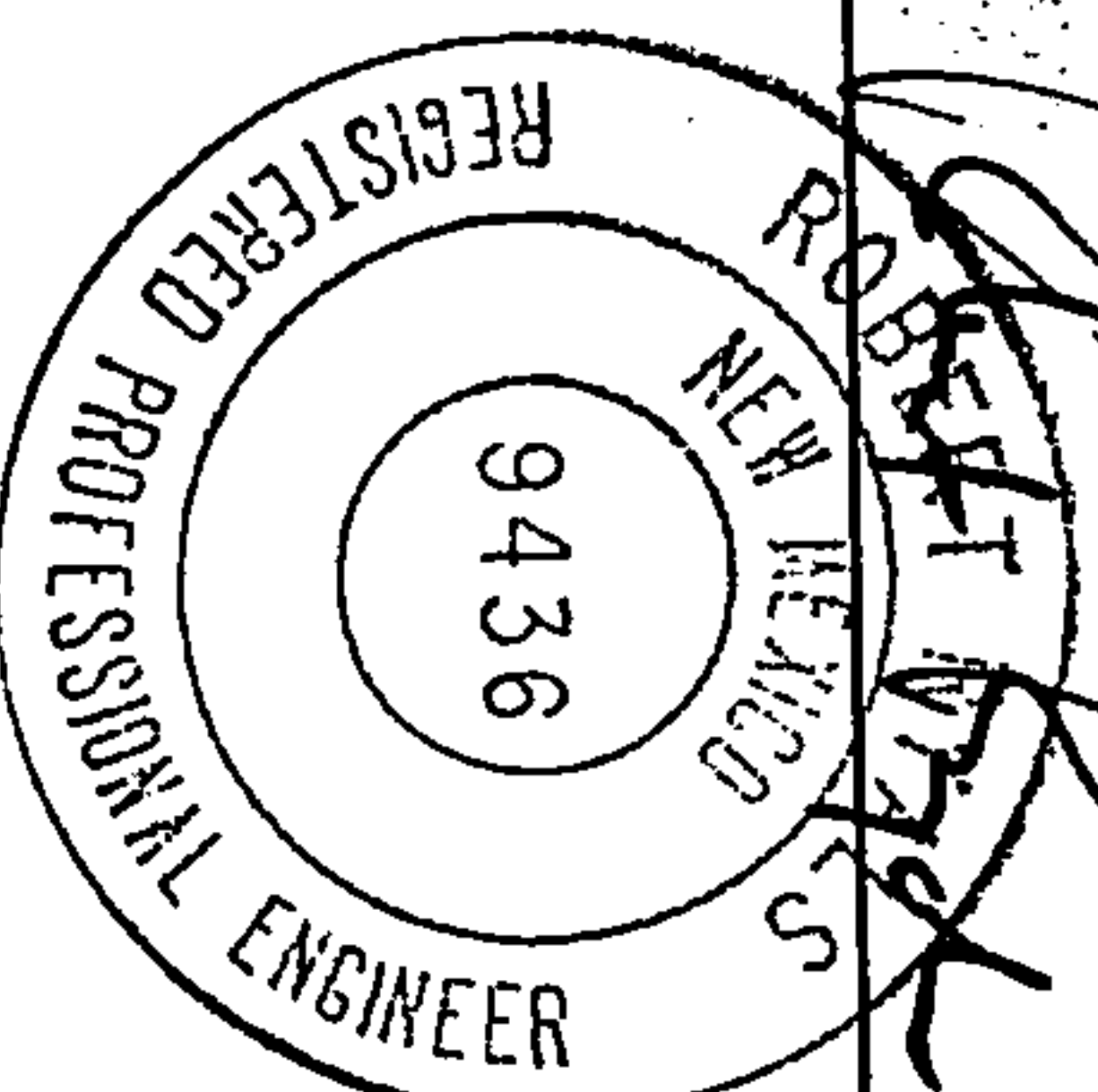


TABLE OF CONTENTS

DRAINAGE REPORT

- Introduction
- Existing Conditions
- Developed Conditions
- Recommendations
- Table 1 - Revised Hydrology
- Table 2. - Pipe Culvert Analysis

EXHIBITS

- 1. Plat Map of Study Area
- 2. Paving Plan and Profile Drawing

APPENDIX

- 1. Drainage Report for Four Hills Village 18th
Installment, Dated November 1978, by
Andrews, Asbury & Robert, Inc.

**DRAINAGE REPORT
FOR
RON JOHNSON ACCESS ROAD
FOUR HILLS VILLAGE
CITY OF ALBUQUERQUE**

INTRODUCTION

This report presents the storm drainage analysis that was done to determine the size and quantity of culverts needed to safely pass the 100-year frequency flood flow at the access road crossing of the diversion channel.

EXISTING CONDITIONS

Briefly summarizing the AAR report, a development company, Paul's Homes, wanted to develop land for a subdivision within Four Hills Village, 19th Installment. AAR analyzed both onsite and offsite drainage in the vicinity of the proposed subdivision. Offsite drainage included runoff into the future Four Hills Diversion Channel. Subbasins D-3 through D-8 delineated in that report form the watershed that generates all the runoff into the diversion channel at the location of the proposed access road crossing.

200

subbasin. The total discharge calculated for the 71.8 acre drainage area was 186.7 cfs. The AAR report had calculated a total discharge of 179.5 cfs.

The Four Hills Diversion Channel intercepts major runoff flows east of the Four Hills Village. The channel, which directs the flow in a southerly direction toward the Four Hills Arroyo, is approximately 2,800 feet long and runs from north to south. The western side of the ditch, which protects Four Hills Village, has a berm of 4 feet in height and a top width of 12 to 15 feet. The eastern side does not have a berm. The channel and the land to east side are designated as Open Space.

DEVELOPED CONDITIONS

The access road will be gravel and convey only a light amount of traffic. The proposed method to carry storm water flow at the access road crossing is by using corrugated metal pipe (c.m.p.). To determine the size and quantity of c.m.p. that will be needed, an analysis of existing channel capacity was conducted. Several channel sections up and downstream of the Stagecoach road right-of-way were surveyed. Typically, these channel sections had side slopes of 3:1, depths of 4 feet from flowline to top of berm, and bottom widths that varied from 12 to 20 feet. The average channel slope was approximately 0.25%. Normal depth calculations were made at several of the cross-sections. Flow was determined to be subcritical with an average normal depth of approximately 2.4 ft. This figure was used as the tailwater depth in the culvert analysis.

A 75-ft. long culvert will be needed to accommodate the roadway width. Several pipe sizes and quantities were looked at that would contain the full 100-year flow. It was determined that two 54" diameter pipes could contain the entire 186.7 cfs. flow without overtopping the crown. The Table 2 summarizes the pipe flow analysis for several discharges for a 54" c.m.p.

RECOMMENDATIONS

Two 54" c.m. pipes will be constructed to contain the 100-year flow. The existing berm along the eastern side of the channel will be raised to accommodate the extra height of the culverts. The minimum fill covering the pipes will be one foot. The two culverts will be 75 feet long and projecting at each end from the roadfill. Erosion protection will be provided as needed on the upstream and downstream ends of the pipe. Exhibit No.2 is the paving plan and profile for the proposed project.

TABLE 1.

FILE = RONJON.WQ1
 ALBUQUERQUE, NM, DPM (1/93) CRITERIA - SIMPLE PROCEDURE FOR <= 40 ACRES
 PX100-6 = PRECIPITATION EXCESS FROM 100-YEAR 6-HOUR STORM
 VOL10D = VOLUME OF RUNOFF FROM 100-YEAR 10-DAY STORM
 TRMT CLASS A=UNDISTURBED, B=LAWNS, C=UNPAVED ROADS, D=ROOFS, PAVEMENT
 SEE DPM P 22.5-5

***** PROJECT INFO *****

RON JOHNSON PROJECT
 CITY OF ALBUQUERQUE
 EXISTING CONDITIONS FROM "DRAINAGE REPORT FOR FOUR HILLS VILLAGE
 19TH INSTALLMENT SITE IMPROVEMENTS (ANDREWS, ASBURY & ROBERT, INC.; NOV,1978)

RAIN ZONE 3 SEE DPM P 22.2-2

-100-YEAR PRECIPITATION (P) DEPTHS, INCHES

	1 HR	6 HR	24 HR	4 DAY	10 DAY
	2.14	2.60	3.10	3.95	4.90

01/08/96		02:21 PM EXISTING CONDITIONS - SUBBASIN D-3					
TRMT	AREA	AREA	PX100-6	QP100-6	QP100-6	VOL6HR	
CLASS	SQUARE FT.	ACRES	IN/AC	CFS/AC	CFS	AC-FT	
A	0.00	0.0000	0.66	1.87	0.000	0.000	
B	217800.90	5.0000	0.92	2.60	13.000	0.383	
C	0.00	0.0000	1.29	3.45	0.000	0.000	
D	0.00	0.0000	2.36	5.02	0.000	0.000	
TOTAL	217800.90	5.0000			13.000	0.383	
					CU FT	16698	

01/08/96		02:21 PM EXISTING CONDITIONS - SUBBASIN D-4					
TRMT	AREA	AREA	PX100-6	QP100-6	QP100-6	VOL6HR	
CLASS	SQUARE FT.	ACRES	IN/AC	CFS/AC	CFS	AC-FT	
A	0.00	0.0000	0.66	1.87	0.000	0.000	
B	239581.00	5.5000	0.92	2.60	14.300	0.422	
C	0.00	0.0000	1.29	3.45	0.000	0.000	
D	0.00	0.0000	2.36	5.02	0.000	0.000	
TOTAL	239581.00	5.5000			14.300	0.422	
					CU FT	18368	

01/08/96		02:21 PM EXISTING CONDITIONS - SUBBASIN D-5					
TRMT	AREA	AREA	PX100-6	QP100-6	QP100-6	VOL6HR	
CLASS	SQUARE FT.	ACRES	IN/AC	CFS/AC	CFS	AC-FT	
A	0.00	0.0000	0.66	1.87	0.000	0.000	
B	82764.30	1.9000	0.92	2.60	4.940	0.146	
C	0.00	0.0000	1.29	3.45	0.000	0.000	
D	0.00	0.0000	2.36	5.02	0.000	0.000	
TOTAL	82764.30	1.9000			4.940	0.146	
					CU FT	6345	

01/08/96		02:21 PM EXISTING CONDITIONS - SUBBASIN D-6					
TRMT	AREA	AREA	PX100-6	QP100-6	QP100-6	VOL6HR	
CLASS	SQUARE FEI	ACRES	IN/AC	CFS/AC	CFS	AC-FT	
A	0.00	0.0000	0.66	1.87	0.000	0.000	
B	117612.50	2.7000	0.92	2.60	7.020	0.207	
C	0.00	0.0000	1.29	3.45	0.000	0.000	
D	0.00	0.0000	2.36	5.02	0.000	0.000	
TOTAL	117612.50	2.7000			7.020	0.207	
					CU FT	9017	

01/08/96 02:21 PM EXISTING CONDITIONS - SUBBASIN D-7

TRMT	AREA	AREA	PX100-6	QP100-6	QP100-6	VOL6HR
CLASS	SQUARE FEI	ACRES	IN/AC	CFS/AC	CFS	AC-FT
A	0.00	0.0000	0.66	1.87	0.000	0.000
B	191664.80	4.4000	0.92	2.60	11.440	0.337
C	0.00	0.0000	1.29	3.45	0.000	0.000
D	0.00	0.0000	2.36	5.02	0.000	0.000
TOTAL	191664.80	4.4000			11.440	0.337
					CU FT	14694

01/08/96 02:21 PM EXISTING CONDITIONS - SUBBASIN D-8

TRMT	AREA	AREA	PX100-6	QP100-6	QP100-6	VOL6HR
CLASS	SQUARE FEI	ACRES	IN/AC	CFS/AC	CFS	AC-FT
A	0.00	0.0000	0.66	1.87	0.000	0.000
B	2278197.10	52.3002	0.92	2.60	135.981	4.010
C	0.00	0.0000	1.29	3.45	0.000	0.000
D	0.00	0.0000	2.36	5.02	0.000	0.000
TOTAL	2278197.10	52.3002			135.981	4.010
					CU FT	174662

01/08/96 02:21 PM EXISTING CONDITIONS - TOTAL RUNOFF (D-3 THRU D-8)

TRMT	AREA	AREA	PX100-6	QP100-6	QP100-6	VOL6HR
CLASS	SQUARE FEI	ACRES	IN/AC	CFS/AC	CFS	AC-FT
A	0.00	0.0000	0.66	1.87	0.000	0.000
B	3127620.00	71.8003	0.92	2.60	186.681	5.505
C	0.00	0.0000	1.29	3.45	0.000	0.000
D	0.00	0.0000	2.36	5.02	0.000	0.000
TOTAL	3127620.00	71.8003			186.681	5.505
					CU FT	239784

TABLE 2.

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

December 11, 1995
RON JOHNSON PROJECT
CMP CULVERT ANALYSIS
TOTAL Q = 186 CFS. (100-YEAR EVENT)

PROGRAM INPUT DATA:	VALUE
Culvert Diameter (feet).....	4.50
FHWA Chart Number (1,2 or 3).....	2
Scale Number on Chart (Type of Culvert Entrance).....	3
Manning's Roughness Coefficient (n-value).....	0.0240
Entrance Loss Coefficient of Culvert Opening.....	0.50
Culvert Length (feet).....	75.0
Culvert Slope (feet per foot).....	0.0025

PROGRAM RESULTS:							
Flow Rate (cfs)	Tailwater Depth (ft)	Inlet Headwater (ft)	Outlet Control (ft)	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
186.7	2.40	10.05	9.53	4.50	3.94	4.50	11.74
<i>2 pipes</i> 93.4	2.40	4.76	4.86	4.50	2.84	2.84	8.85
62.2	2.40	3.58	3.82	4.50	2.29	2.40	7.21
46.7	2.40	2.97	3.39	3.27	1.97	2.40	5.41
37.3	2.40	2.59	3.16	2.77	1.76	2.40	4.32
31.1	2.40	2.32	3.01	2.47	1.60	2.40	3.61

PIPE CULVERT ANALYSIS COMPUTER PROGRAM Version 1.7 Copyright (c)1986
Dodson & Associates, Inc., 7015 W. Tidwell, #107, Houston, TX 77092
(713) 895-8322. All Rights Reserved.

APPENDIX

Drainage Report
Four Hills Village Installment 19
Prepared by Andrews Asbury and Robert, Inc.
Date of Report: November 1978

INCLUDED FOR REFERENCE ONLY

PAUL'S HOMES, INC.
ALBUQUERQUE, NEW MEXICO

DRAINAGE REPORT
FOR
FOUR HILLS VILLAGE
NINETEENTH INSTALLMENT
SITE IMPROVEMENTS

NOVEMBER 1978

ANDREWS, ASBURY & ROBERT, INC.
Consulting Engineers
401 San Pedro, N. E.
Albuquerque, New Mexico 87108
505-265-6631

DRAINAGE REPORT
FOR
FOUR HILLS VILLAGE
NINETEENTH INSTALLMENT
SITE IMPROVEMENTS

TABLE OF CONTENTS

	<u>PAGE</u>
I Introduction	1
II Existing Conditions	2
A. Off site Drainage	2
B. On site Drainage	4
III Developed Conditions	5
A. Four Hills Diversion Ditch	5
B. Four Hills Arroyo	6
C. On site Drainage control	7
IV Lot Ponding Requirements	8
<u>MAPS</u> Location Map	Map No. 1
Off site Drainage	Map No. 2
V Design Analysis	11
	Sheets 1 through 30
<u>MAPS</u> Existing Conditions	Map No. 3
Developed Conditions	Map No. 4
(See special pocket at back of report for Map No. 3 and Map No. 4)	

I

INTRODUCTION

Paul's Homes, Inc. proposes to improve and develop a 53.7 acre tract of land designated as Four Hills Village, Nineteenth Installment, a subdivision located in the far southeast quadrant of the City of Albuquerque. This subdivision is bounded on the south by lands of Kirtland Air Force Base, on the west by Four Hills Village, Installment Seventeen, and on the north and east by Four Hills Village, Installments Eleven, Twelve and Thirteen. (See enclosed Location Map, Map No. 1, page M-23 of the Zone Atlas.)

The storm drainage analysis included in this drainage report was made to determine the storm water runoff anticipated in the event of a 100-year frequency storm and to provide a plan to control storm water runoff under the proposed developed conditions that will conform to applicable drainage resolutions and ordinances.

In order to provide a comprehensive drainage analysis for the Nineteenth Installment it was necessary to study the surrounding and adjacent platted subdivisions including portions of the 11th, 12th, 13th, 17th and 5th Installments of Four Hills Village. The results of this study are included in this report.

II

EXISTING CONDITIONS

The Four Hills Village, Nineteenth Installment subdivision, consists of ground surfaces relatively broken and steep having grades varying from 4% to 7% and presently undeveloped. However, the area lying directly to the west, north, and along the major portion of the east side is in a developed condition. All adjacent development is in residential use.

The south side of the subdivision is bounded by lands of Kirtland Air Force Base. These lands are completely undeveloped and exist in a natural and native condition.

One of the main drainage features of this subdivision consists of a major arroyo, hereinafter referred to as the Four Hills Arroyo, that bisects the subdivision in a southeasterly-northwesterly direction.

A. OFFSITE DRAINAGE

Offsite areas generating storm water runoff to the subdivision are located northeast, east and southeast of the subdivision site and are shown on Map No. 2 and Map No. 3 enclosed herein.

A runoff factor (c) of 0.50 was chosen for use in

determining the runoff rate from offsite drainage areas. This runoff factor determination was based on site field investigations of the areas. The developed areas have a reasonable amount of built-in rear or side yard ponding and sometimes the front yard, to compensate in the majority of the area for the increased rate of runoff created by the hard surface areas. The developed areas combined with the undeveloped areas that have a fairly open graded soil and good vegetative cover allow the factor as chosen to be considered conservative.

1. FOUR HILLS ARROYO - OFFSITE AREA

The offsite drainage area of the Four Hills Arroyo consists of 603.3 acres and is shown on Map No. 2. Limits of the drainage area were determined from Kirtland Base engineer topographic maps. These maps are at a scale of 1" = 200' with contour intervals of 2 feet and were made available by the Albuquerque Metropolitan Arroyo Flood Control Authority. Prints of such maps are on file at the AMAFCA office.

2. OTHER OFFSITE AREAS

The drainage area limits of the offsite areas other than the Four Hills Arroyo were determined from a combination of methods. Orthophoto topographic mapping at a scale of 1" = 200' was utilized where such mapping was available. The remainder of the area limits was determined from USGS topographic maps at a scale of 1" = 2000' along with field site investigations.

As a result of the study made of the offsite drainage areas it was determined that some existing streets in the Four Hills area are unable to carry the flows generated by a 100-year frequency storm and that some residences in the area are subject to flooding conditions by storms of a much lesser magnitude.

B. ON SITE DRAINAGE

On site drainage under existing conditions is shown on Map No. 2 enclosed herein. The on site drainage north and east of the Four Hills Arroyo is carried to the arroyo by natural drainage channels.

The southwest portion of the subdivision site drains into the 17th installment street system. The present street system carries the flows west and north to a lined drainage easement channel that empties into the Four Hills Arroyo. (See Map No. 2).

The drainage analysis and computations are included hereinafter in this report.

III

DEVELOPED CONDITIONS

The proposed method of both on site and off site drainage for the subdivision under developed conditions is shown on Map No. 4 enclosed herein.

A. FOUR HILLS DIVERSION DITCH

As shown on Map No. 4 it is proposed to build a diversion ditch approximately 2800 feet in length, herein-after referred to as Four Hills Diversion Ditch, along a north-south alignment and located east of the Four Hills Village area. This diversion ditch will intercept all major runoff flows from the off site drainage areas to the east and direct them southerly to the Four Hills Arroyo.

Permission to construct approximately 300 feet of the diversion ditch on the lands of Kirtland Air Force Base has been formally requested by the City of Albuquerque from the Base Engineer approximately 60 days ago. At the time of this writing an answer has not been received as to whether permission will be granted to extend the outlet of the diversion ditch onto Kirtland Base lands. Indications are that permission will be granted.

An alternate to construction of the outlet of the

diversion ditch on the lands of Kirtland Air Force Base would be the construction of a concrete lined channel along the southerly boundary of the subdivision. Limits of this concrete lined channel would be from the point of intersection of the diversion ditch with the north boundary of Kirtland Base, westerly to the Four Hills Arroyo. (See Map No. 4.)

B. FOUR HILLS ARROYO

As shown on Map No. 4 it is proposed to provide channelization and improvements to the Four Hills Arroyo through the 19th Installment and to the west along the north boundary of the 17th Installment.

Improvements of the arroyo in the 19th Installment include bank protection to confine the flows within the dedicated drainage right-of-way. This bank protection will be provided along the banks of the arroyo between the existing rock outcroppings and will consist of dikes with wire tied rip rap for erosion protection. Other than this bank protection, the arroyo shall be left in its natural state including preservation of the existing vegetation during construction.

Improvements of the arroyo along the north boundary of the 17th Installment consist of constructing a concrete lined channel. Concrete lining of the arroyo along this reach is necessary due to the encroachment of fill into the arroyo

during grading operations performed when developing the 17th
Installation. Limits of the proposed lining are shown on Map
No. 4.

A drainage structure (dry weather crossing) consisting of five (5) 60-inch diameter culvert pipe is proposed to be constructed for the Wagontrain Drive crossing of the arroyo. Erosion protection upstream and downstream of the structure should be provided.

C. ON SITE DRAINAGE CONTROL

Guidelines to be used in controlling storm water runoff when developing the subdivision shall be as follows:

1. Provide for backyard and/or roof ponding as necessary so as not to increase the volume and rate of runoff due to development of the subdivision. Consideration shall be given to the fact that due to the steep terrain on which this subdivision is located, ponding cannot be accomplished on some lots. However, in considering the total area of the subdivision there shall be sufficient total ponding provided so as not to increase runoff due to development of the subdivision.

2. Runoff and ponding determinations shall be made based on the following surfaces or equivalent.

Front yard and street area	
Hard surfaced area	50%
Landscaped area	50%
Back yard area	
Hard surfaced area	18%
Landscaped area	82%

IV

LOT PONDING REQUIREMENTS

Units to be constructed on lots in this subdivision will consist of residential units varying in size from 2000 ft² to 3000 ft².

The basis and factors for determining lot ponding requirements are shown on sheet 15 of the design analysis. From this sheet 15, the volume per square foot of lot area to be ponded is 0.108 ft³.

Following is a tabulation of the lot ponding requirements:

FOUR HILLS VILLAGE 19th INSTALLMENT

LOT PONDING REQUIREMENTS

Block	Lot No.	Storage Volume (CF)
17-A	42	1268
	43	1429
	44	916
	45	1026
	45	1134
	47	1242
	48	1441
	49	2453
	50	838
	51	1613
17-A	21	1199
	22	850
	23	1354
	24	1029
	25	1476
	26	-0-
	27	-0-
45-A		

LOT PONDING REQUIREMENTS (Continued)

Block	Lot No.	Storage Volume (CF)
45-A	28	1134
	29	893
	30	1121
	31	1287
	32	1188
	33	1188
	34	1188
	35	1188
	36	1188
	37	1188
45-A	11	-0-
	12	1381
	13	1460
	14	699
	15	-0-
	16	-0-
	17	1307
48-A	18	1083
	19	1294
	20	-0-
	21	-0-
	21	-0-
48-A	3	865
	4	1257
	5	1916
	6	1329
	7	950
	8	950
	9	950
	10	950
	11	975
	12	1107
49-A	13	1892
	14	1772
	15	1188
	16	1188
	17	1188
	18	626
	19	551
	20	-0-
	21	-0-
	22	-0-
49-A	23	-0-
	24	2226

LOT PONDING REQUIREMENTS (Continued)

Block	Lot No.	Storage Volume (CF)
50-A	2	549
	3	662
	4	954
	5	1001
	6	739
	7	972
	8	972
	9	972
	10	811
	11	1865
	12	1339
50-A	22	731
51-A	23	2129
	24	-0-
	25	-0-
	26	-0-
51-A	27	1755
54-A	22	1026
	23	1080
	24	1080
	25	864
	26	1688
	27	886
	28	799
	29	799
	30	799
	31	799
	32	-0-
	33	3313
54-A	34	1522
	35	1242
	36	2339
	37	-0-
	38	-0-
	39	1970
	40	1487
	41	1459
	42	794
	43	616
	44	-0-
	45	864
54-A	46	864
	47	-0-
	48	-0-
	49	-0-

V

DESIGN ANALYSIS

Included hereinafter are the drainage analyses (computations) for the subject subdivision. (See sheets 1 through 30).

FOUR HILLS VILLAGE
NINETEENTH INSTALLMENT
SITE IMPROVEMENTS

DRAINAGE ANALYSIS

Sheet

Criteria, Reference Material
and Design Parameters

1

EXISTING CONDITIONS

Drainage Area	A	2
	B	3
	C	3
	D	4
	E	4
Four Hills Arroyo		5

DEVELOPED CONDITIONS

Four Hills Diversion Ditch	8
Individual Areas	8 - 10
Combined Areas	11 - 13
Lot Runoff Factors & Ponding Factors	14 - 15
Drainage Area C	16
Street Flows	
Drainage Area D	17 - 18
Street & Easement Flows	
Drainage Area E	19
Street & Easement Flows	
Four Hills Arroyo	20 - 22

FACILITY DESIGN

Four Hills Diversion Ditch	23 - 24
Four Hills Arroyo	25 - 27
Camino Cerrito	28
Drainage Easement Channel, Lots 43 & 44, Blk 17	29
Conestoga Drive Cul de Sac	30

DRAINAGE ANALYSIS

CRITERIA-

DESIGN STORM - 100 Year Frequency

REFERENCE MATERIAL

1. Albuquerque Area (1961) Intensity Duration - Frequency Curves
2. 100 Year - 6 Hour Precipitation Rainfall Frequency Map for New Mexico - U.S. Weather Bureau. 1967
3. Time of Concentration Nomograph by R.Z. Kirpich.

DESIGN PARAMETERS

Peak Runoff Rate - Rational Formula
 $Q = CIA$

Runoff Volume - $V = \text{Runoff Coefficient} \times \text{Rainfall} \times \text{Area}$

Runoff Coefficients

Offsite & Existing Conditions = 0.50
Hard Surface = 0.90
Landscaped Surface = 0.40

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Project FOUR HILLS VILLAGE Sheet 2 of 30
19TH INSTALLMENT Job No. 130
By JH Chkd _____ Date 11-28-73

EXISTING CONDITIONS

For offsite drainage Areas - See Map No. 2
and for on site drainage Areas - See Map No. 3.

Drainage Area A -

@ South Boundary of 19th Installment.

Area = 603.3 Acres

To determine (T_c) Time of Concentration
Drainage Area is divided into
four reaches.

<u>Reach</u>	<u>Length</u>	<u>Elev. High. Low</u>	<u>Elev. Diff.</u>	<u>T_c</u>
1	1200'	6530-6400	180'	5 min.
2	1000'	6400-6320	80'	6 "
3	3500'	6320-6080	240'	9 "
4	3700'	6080-5896	184'	10 "
Total				$T_c = 30 \text{ min.}$

$$I = 3.44, \quad C = 0.50$$

$$Q = (0.50)(3.44)(603.3) = \underline{\underline{1033 \text{ CFS}}}$$

@ South Endry of
Subdivision.

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Project FOUR HILLS WILLOWS Sheet 3 of 30
19TH INSTALLMENT Job No. 130
By JA Chk'd L Date 11-28-78

EXISTING CONDITIONS. CONT'D

Drainage Area B.

@ Entrance to Four Hills Arroyo -
See map No. 3

Area = 21.1 Acres

Length of Area = 2800'

Elev. Diff = 6028 - 5857 = 171'

$T_c = 11 \text{ min.}$ $I = 5.25$

$$Q = (0.50)(5.25)(21.1) = \underline{\underline{55 \text{ CFS}}}$$

DRAINAGE AREA C

@ Entrance to Four Hills Arroyo
Near Wagontrain Drive - See map No. 2
and map No. 3.

Area = 117.0 Acres

Drainage Area is divided into 3 reaches

Reach	Length	Elev High - Low.	Elev. Diff	T_c
1	500'	6560 - 6400	160'	3 min
2	4700'	6400 - 5966	434'	12 "
3	2450'	5966 - 5827	139'	6 "

Total $T_c = 21 \text{ min.}$

$I = 3.9$

$$Q = (0.50)(4.1)(117.0) = \underline{\underline{240 \text{ CFS}}}$$

EXISTING CONDITIONS - CONT'D

DRAINAGE AREA D

@ Entrance to Four Hills Arroyo Southwest
of Camino Cerro to Caballero Drive,
Area = 154.6 Acres

Drainage Area is divided into 3 reaches.

<u>Reach</u>	<u>Length</u>	<u>Elev. High</u>	<u>Elev. Low</u>	<u>Elev. Diff</u>	<u>Tc</u>
1	4000'	6330	5968	362	12 min.
2	1800'	5968	5846	122	7 min.
3	1700'	5846	5789	57	6 min.

Total Tc = 25 min.

$$I = 3.9$$

$$Q = (0.50)(3.9)(154.6) = \underline{\underline{301 \text{ CFS}}}$$

DRAINAGE AREA E

@ Entrance of drainage channel in
17th Installment North of Castillano Rd &
Cotton Avenue Intersection.

$$\text{Area} = 41.6 \text{ Acres}$$

$$\text{Length Drainage Area} = 3870'$$

$$\text{Elev. Diff} = 5896 - 5746 = 150' \quad Tc = 11 \text{ min.}$$

$$I = 5.25$$

$$Q = (0.50)(5.25)(41.6) = \underline{\underline{109 \text{ CFS}}}$$

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Project FOUR HILLS VILLAGE Sheet 5 of 30
19TH INSTALLMENT Job No. 130
By JH Chkd L Date 11-28-73

EXISTING CONDITIONS CONT'D

FLOW RATES IN FOUR HILLS ARROYO

Combined Drainage Areas A, B, A-1 & A-2

@ Wagontrain Drive

$$\text{Area} = 603.3 + 21.1 + 8.3 + 3.4 = 636.1 \text{ Acres}$$

$$\begin{aligned} T_c \text{ of Area A plus channel flow time} \\ = 30 \text{ min} + 2 \text{ min} = 32 \text{ min.} \end{aligned}$$

$$I = 3.32$$

$$Q = (0.50)(3.32)(636.1) = \underline{\underline{1056 \text{ CFS}}}$$

Combined Drainage Areas

A, B, A-1, A-2, C & A-3

@ Boundary of 19th Installment & 17th Install.

$$\text{Area} = 636.1 + 117.0 + 7.5 = 760.6 \text{ Acres}$$

$$T_c = \text{Above } t_c \text{ plus channel flow time}$$

$$= 32 \text{ min.} + 1 \text{ min} = 33 \text{ min.}$$

$$I = 3.26$$

$$Q = (0.50)(3.26)(760.6) = \underline{\underline{1240 \text{ CFS}}}$$

EXIST. CONDITIONS - CONT'D -

Combined Drainage Areas

A, B, A-1, A-2, C, A-3 & D

@ entrance of flow from drainage Area D.

$$\text{Area} = 760.6 + 154.6 = 915.2$$

$$T_c = \text{Same as above} = 33 \text{ min} - I = 3.26$$

$$Q = (0.50)(3.26)(915.2) = \underline{\underline{1492 \text{ CFS}}}$$

Combined Drainage Areas -

Same as above plus A-4 & E.

@ Point where flow from 17th Installment enters Four Hills Arroyo

$$\text{Area} = 915.2 + 8.3 + 41.6 = 965.1$$

$$T_c = \text{Above } T_c + \text{Channel Flow time} =$$

$$= 33 \text{ min} + 2 = 35 \text{ min.}$$

$$I = 3.15$$

$$Q = (0.50)(3.15)(965.1) = 1520 \text{ CFS}$$

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Project FOUNTAIN HILLS ARROW Sheet 7 of 30
19TH INSTALLMENT Job No. 130
By JH Chkd ✓ Date 11-23-78

EXISTING CONDITIONS. CONT'D

Combined Drainage Areas -

Total - A thru E including A-5

Area = 965.1 + 2.9 = 968 - Acres

T_c = Same as above = 35 min.

$I = 3.15$

$Q = (0.50)(3.15)(968) = \underline{\underline{1.525 \text{ CFS}}}$

NOTE

See Map No. 3 for Existing Condition
Flows & Areas,

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Project FOUR HILLS Sheet 8 of 30
19TH INSTALLMENT Job No. 130
By JH. Chkd — Date 11-1-73

DEVELOPED CONDITIONS

Following is the drainage analysis for the proposed developed & improved conditions - (See Map No. 4)

FOUR HILLS - DIVERSION DITCH

See MAP NO 4 for designation & location of Drainage Areas.

Drainage Area (DA) D-3

Area = 5.0 Acres

T_c - less than 10 min - Use $I = 5.4$

$C = 0.50$

$$Q = CIA = (0.50)(5.4)(5.0) = \underline{\underline{13.5 \text{ cfs}}}$$

DA - D-4

Area = 5.5 Ac.

$T_c < 10 \text{ min}$ - Use $I = 5.4$

$$Q = (0.50)(5.4)(5.5) = \underline{\underline{14.8 \text{ cfs}}}$$

DA - D-5

Area = 1.9 Ac. , $I = 5.4$

$$Q = (0.50)(5.4)(1.9) = \underline{\underline{5.1 \text{ cfs}}}$$

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Project FOUR HILLS Sheet 9 of 30
19TH INSTALLMENT Job No. 130
By JA Chkd ✓ Date 11-1-78

DIVERSION DITCH - CONT'D

DA - D-6

Area = 2.7 Acres, I = 5.4

$$Q = (0.50)(5.4)(2.7) = \underline{\underline{7.3 \text{ CFS}}}$$

DA - D-7

Area = 4.4 Acres, I = 5.4

$$Q = (0.50)(5.4)(4.4) = \underline{\underline{11.9 \text{ CFS}}}$$

DA - D-8

Area = 52.3 Acres

$$\text{Elev. Diff.} = 6330 - 5968 = 382'$$

$$\text{Length} = 4000'$$

$$T_c = 12 \text{ min.} \quad I = 5.0$$

$$Q = (0.50)(5.0)(52.3) = \underline{\underline{130.8 \text{ CFS}}}$$

DA - C-1

Area = 14.7 Acres, I = 5.4

$$Q = (0.50)(5.4)(14.7) = \underline{\underline{39.7 \text{ CFS}}}$$

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Project 4-HILLS Sheet 10 of 30
19TH INSTALLMENT Job No. 13
By JA Chkd — Date 11-1-78

DIVERSION DITCH, CONT'D

DA-C-2

Area = 68.3 Acres

Elev. Diff. = Reach 1 - 6560-6400 = 160', 49, 500'

Reach 2 - 6400-5966 = 434', 49, 4700'

$T_c = \text{Reach 1} = 3 \text{ min.}$

Reach 2 = 12 min.

Total = 15 min, $I = 4.6$

$Q = (0.50)(4.6)(68.3) = \underline{\underline{157.1 \text{ CFS}}}$

DA-B-1

Area = 7.0 Acres, $I = 5.4$

$Q = (0.50)(5.4)(7.0) = \underline{\underline{18.9 \text{ CFS}}}$

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Project FOUR HILLS Sheet 11 of 30
19TH INSTALLMENT Job No. 130
By JA Chkd — Date 11-1-78

DIVERSION DITCH — FLOW ANALYSIS

Flows from Drainage Areas D-3 through
D-8, C-1 & C-2 and B-1 will be
intercepted by the FOUR HILLS DIVERSION
CHANNEL.

DA - D-3 - See Sheet 8

$$Q = \underline{13.5 \text{ CFS}}$$

DA - D-3 & D-4

$$\text{Area} = 5.0 + 5.5 = 10.5 \text{ Acres,}$$

$$I = 5.4$$

$$Q = (0.50)(5.4)(10.5) = \underline{28.4 \text{ CFS}}$$

DA - D-3, D-4 & D-5

$$\text{Area} = 10.5 + 1.9 = 12.4 \text{ Acres}$$

$$I = 5.4$$

$$Q = (0.50)(5.4)(12.4) = \underline{33.5 \text{ CFS}}$$

DA - D-3 thru D-6

$$\text{Area} = 12.4 + 2.7 = 15.1 \text{ Acres}$$

$$T_c < 10 \text{ min. Use } I = 5.4$$

$$Q = (0.50)(5.4)(15.1) = \underline{40.8 \text{ CFS}}$$

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Project FOUR HILLS Sheet 12 of 30
19 TH INSTALLMENT Job No. 150
By JH Chkd L Date 11-1-73

DIVERSION DITCH CONT'D

DA - D-3 THRU D-7

Area = 15.1 + 4.4 = 19.5 Acres

I = 5.4

$$Q = (10.50)(5.4)(19.5) = \underline{\underline{52.6 \text{ CFS}}}$$

DA - D-3 THRU D-8

Area = 19.5 + 52.3 = 71.8 Acres

T_c - Same as for Drainage Area D-8
= 12 min.

I = 5.0

$$Q = (10.50)(5.0)(71.8) = \underline{\underline{179.5 \text{ CFS}}}$$

DA - D-3 THRU D-8 & C-1

Area = 71.8 + 14.7 = 86.5 Acres

T_c = Same as above - 12 min. + channel
flow time.

Channel flow time = 900' @ 5 fps = 3 min.

T_c = 12 min + 3 min. = 15 min.

I = 4.6

$$Q = (10.5)(4.6)(86.5) = \underline{\underline{199.0 \text{ CFS}}}$$

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Project FOUR HILLS Sheet 13 of 30
19TH INSTALLMENT Job No. 1-30
By Jed Chkd ✓ Date 11-1-78

DIVERSION DITCH CONT'D

DA - D-3 thru D-8 & C-1 & C-2.

Area = $86.5 + 68.3 = 154.8$ Acres

T_c = Same as above which is equal
to T_c for Drainage Area e-2.

= 15 min.

$I = 4.6$

$Q = (0.50)(4.6)(154.8) = \underline{\underline{356.0 \text{ CFS}}}$

DA - D-3 thru D-8, C-1 & C-2 & B-1

Area = $154.8 + 7.0 = 161.8$ Acres

T_c = Same as above - 15 min. + channel
flow time.

Channel flow time = 700' @ 6 fps = 2 min.

$T_c = 15 \text{ min} + 2 \text{ min} = 17 \text{ min}$

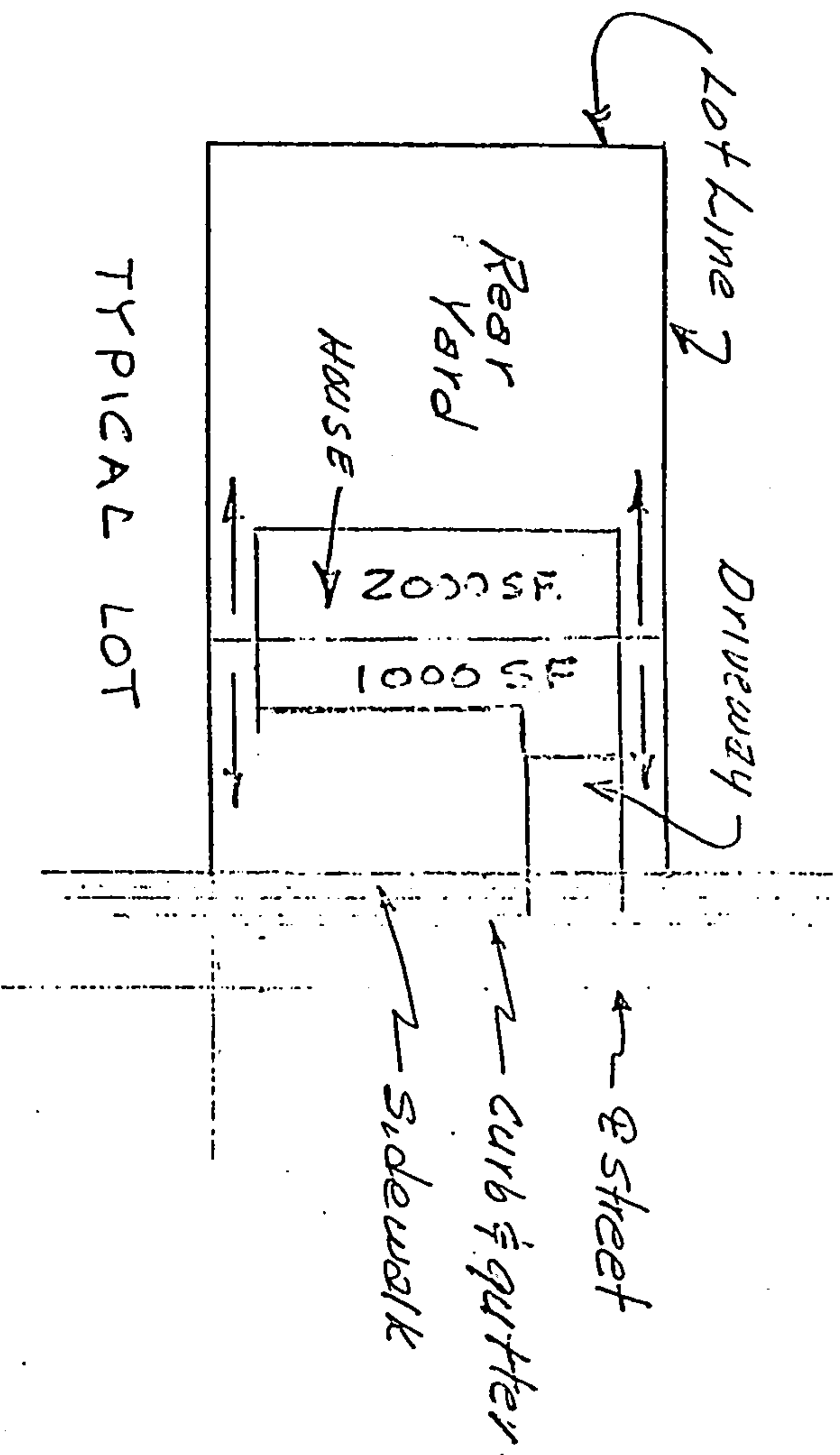
$I = 4.5$

$Q = (0.50)(4.5)(161.8) = \underline{\underline{364.0 \text{ CFS}}}$

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Project FE 0112 11/12/73 Sheet 14 of 30
By W Chkd — Date 11-26-73

DEVELOPED CONDITIONS



Runoff Factors.

Front Yard & Street Area.

Paved Area = 100 x 16.62 = 1662 sq ft
 Street = 100 x 4 + 4 x 25 = 500 sq ft
 Side Walk = 20 x 29.38 = 587.6 sq ft
 Driveway = 2750 sq ft

Roof Area

Total Hard Surface

Total Area = 75 x 100 = 7500 sq ft

Hard Surface = $\frac{3750}{7500} = 50\%$

Land Scaped Area = 100 - 50 = 50%

Runoff Factor = $(0.50)(0.70) + (0.50)(0.40)$

= 0.65

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Project FOUR HILLS VILLAGE Sheet 15 of 30
19TH INSTALLMENT. Job No. 130
By J.A. Chkd Date 11-26-73

Rear Yard

$$\text{Rear Yard Area} = 25 \times 80 = 2000 \text{ ft}^2$$

$$\text{Total Area} = 100 \times 110 = 11,000 \text{ ft}^2$$

$$\text{Hard Surface} = \frac{2000}{11,000} = 18\%$$

$$\text{Land Sequestered} = 100 - 18 = 82\%$$

$$\begin{aligned} \text{Runoff Factor} &= (0.13)(0.30) + (0.82)(0.30) \\ &= \underline{\underline{0.15}} \end{aligned}$$

Ponding Volume

$$V = \text{Rear Yard Area} \times 0.48 \times 3.7' / 12 =$$

$$V = \underline{\underline{\text{Rear Yard Area} \times 0.105 \text{ ft}^3/\text{ft}^2}}$$

NOTE

Due to the steep terrain on which this subdivision is located ponding cannot be accomplished on some lots. However, in considering the total subdivision sufficient ponding shall be provided so as not to increase the volume & rate of runoff due to development.

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Project FOUR HILLS VILLAGE Sheet 16 of 30
19TH INSTALLMENT Job No. 130
By JA Chkd L Date 11-28-78

DEVELOPED CONDITIONS- CONT'D

Following is the drainage analysis of the areas below the diversion ditch.

DRAINAGE AREA C

Flows on Shalako Drive @ Wagontrain.

Area of Drainage = 9.8 Acres.

Portion of area having a 0.65 runoff factor = 6.9 Acres - Front yard.

Portion of area having a 0.48 runoff factor = 2.9 Acres - Rear yard.

$T_c < 10$ min. Use $I = 5.4$

$$Q = (0.65)^{24.2} (5.4)^{7.5} (6.9) + (0.48) (5.4) (2.9) = \underline{\underline{31.7 \text{ CFS}}}$$

Flows on La Cebra (Wagontrain) @ Shalako Dr.

Area = 33.5 Acres, $I = 5.4$, $C = 0.50$

$$Q = (0.50) (5.4) (33.5) = \underline{\underline{90.5 \text{ CFS}}}$$

Flows on Wagontrain Drive @ drainage Structure of Four Hills Arroyo.

Area = 33.5 Ac - @ $C = 0.5$, 8.6 Ac @ $C = 0.65$
2.9 Ac @ $C = 0.48$ - TOTAL AREA = 45 Acres

$$Q = 5.4 [(33.5 \times 0.5) + (8.6 \times 0.65) + (2.9 \times 0.48)] = \underline{\underline{128.1 \text{ CFS}}}$$

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Project FOUR HILLS VILLAGE Sheet 17 of 30
19TH INSTALLMENT Job No. 130
By J.A. Chkd ✓ Date 11-28-78

DEVELOPED CONDITIONS - CONT'D

DRAINAGE AREA D

Flows on Ranch Trail @ Camino Cerrito

Area = 3.6 Acres $T_c < 10 \text{ min} - I = 5.4$

$$Q = (0.65)(5.4)(3.6) = \underline{12.6 \text{ CFS}}$$

Flows on Camino Cerrito @ Caballero Drive

Portion of area having a runoff factor
of 0.50 = 66.6 Acres

Portion of area having a runoff factor
of 0.65 = 6.1 Acres

Drainage Area is Divided into 2 Reaches

Reach	Length	Elev High Low	Elev. Diff	T_c
1	900'	6230-5930	300'	4 min.
2	4280'	5930-5804	126'	14 min

TOTAL $T_c = 18 \text{ min.}$

$$I = 4.4$$

$$Q = 4.4 [(0.50 \times 66.6) + (0.65 \times 6.1)] = \underline{164 \text{ CFS}}$$

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Project FOUR HILLS VILLAGE Sheet 18 of 30
19TH INSTALLMENT Job No. 130
By JF Chkd — Date 11-28-78

DRAINAGE AREA D. CONT'D.

Flows on Caballero Drive @ Camino Cerrito

Area = 2.0 Acres I = 5.4

$$Q = (0.65)(5.4)(2) = \underline{\underline{7.0 \text{ CFS}}}$$

TOTAL Flow @ Intersection of Camino
Cerrito & Caballero Drive

Area = 66.6 Acres @ $C=0.50$ 8.1 Acres @ $C=0.65$

$I = 4.4$ - See previous sheet

$$Q = 4.4 [(0.50 \times 66.6) + (0.65 \times 8.1)] = \underline{\underline{169.7 \text{ CFS}}}$$

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Project FOUR HILLS VILLAGE Sheet 19 of 30
19TH INSTALLMENT Job No. 130
By JA Chkd — Date 11-23-78

Drainage Area E.

Flows on Conestoga Drive Cul de Sac
@ North End.

Area = 2.5 Acres $I = 5.4$

$$Q = (0.65)(5.4)(2.5) = 8.8 \text{ CFS}$$

Flows on Conestoga Drive @ Wagontrain.

Area = 3.0 Acres $I = 5.4$

$$Q = (0.65)(5.4)(3.0) = \underline{\underline{10.5 \text{ CFS}}}$$

Flow on Wagontrain Drive @ West
Boundary & Subdivision.

Area = 4.7 Acres $I = 5.4$

$$Q = (0.65)(5.4)(4.7) = \underline{\underline{16.5 \text{ CFS}}}$$

Flow at Entrance to Four Hills Arroyo
in 17th Installment North of Castellano Rd
& Cotton Avenue Intersection

Area = 29.8 Ac. @ $C = 0.50$, 4.7 Ac. @ $C = 0.65$

Use $I = 5.25$ (See Sheet 4)

$$Q = 5.25 [(0.50 \times 29.8) + (0.65 \times 4.7)] = \underline{\underline{94.3 \text{ CFS}}}$$

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Project FOUR HILLS VILLAGE Sheet 20 of 30
19TH INSTALLMENT Job No. 130
By JA CHK'D _____ Date 11-28-78

DEVELOPED CONDITIONS CONT'D

FOUR HILLS ARROYO

Drainage Area A.

Flow @ South Boundary of Subdivision

Area = Drainage Area A Plus Area
diverted by Diversion Ditch.

Area = 603.3 Ac + 161.8 Acres = 765.1 Ac.

$I = 3.44$ (See Sheet 2)

$$Q = (0.50)(3.44)(765.1) = \underline{\underline{1316 \text{ CFS}}}$$

Flow @ South Side of Wagontrain Dr.

Area = 765.1 + 3.0 = 768.1 Ac.

$I = 3.32$ (See Sheet 5)

$$Q = (0.50)(3.32)(768.1) = \underline{\underline{1275 \text{ CFS}}}$$

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Project FOUR HILLS VILLAGE Sheet 21 of 30
19TH INSTALLMENT Job No. 130
By LT Chkd ✓ Date 11-29-73

DEVELOPED CONDITIONS - CONT'D

FOUR HILLS AREA

Flows @ Boundary of 19TH Installation
& 17TH Installation.

$$\text{Area} = 768.1 + 2.7 = 770.8 \text{ Ac.} + 45 \text{ Ac.} = \text{Drainage Area C}$$

Runoff Factor - Drainage Area C = 0.53

$$T_c = 33 \text{ min. } I = 3.26. \text{ See Sheet 5}$$

$$Q = 3.26 [(0.50 \times 770.8) + (0.53 \times 45)] = \underline{\underline{1334 \text{ CFS}}}$$

Flows @ Entrance of flow from Drainage
Area D (From Camino Cerro to Caballero Dr.)

$$\text{Area} = 770.8 \text{ Ac.} + \text{Drainage Areas C } (45 \text{ Ac.}) \div D (74.7 \text{ Ac.})$$

Runoff Factor - Drainage Area D = 0.52

$$I = 3.26 - \text{Same as above}$$

$$Q = 3.26 [(0.50 \times 770.8) + (45 \times 0.53) + (74.7 \times 0.52)] \\ = \underline{\underline{1461 \text{ CFS}}}$$

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Project FOUR MILES WELL NO. 5 Sheet 22 of 30
19th INSTALLMENT Job No. 130
By JH Chkd — Date 11-29-78

Flows @ Bernalillo Place SE.

@

$$\text{Area} = 770.8 \text{ Ac} + 8.3 + 2.9 = 782 \text{ CFS}$$

$$\text{Plus Drainage Area } C = 45 \text{ Ac.}$$

$$\text{Drainage Area } D = 74.7 \text{ Ac.}$$

$$\text{Drainage Area } E = 34.5 \text{ Ac.}$$

$$17th \text{ Installment Drainage} = 29.8 \text{ Ac.}$$

$$\text{From } 19th \text{ Installment} = 4.7 \text{ Ac.}$$

$$\text{Runoff Factor} = 0.52 -$$

Use $I = 3.26$ - Same as above.

$$Q = 3.26 [(0.50 \times 782) + (0.53 \times 45) + (0.52 \times 74.7) + (0.52 \times 34.5)]$$

$$Q = \underline{\underline{1538 \text{ CFS}}}$$

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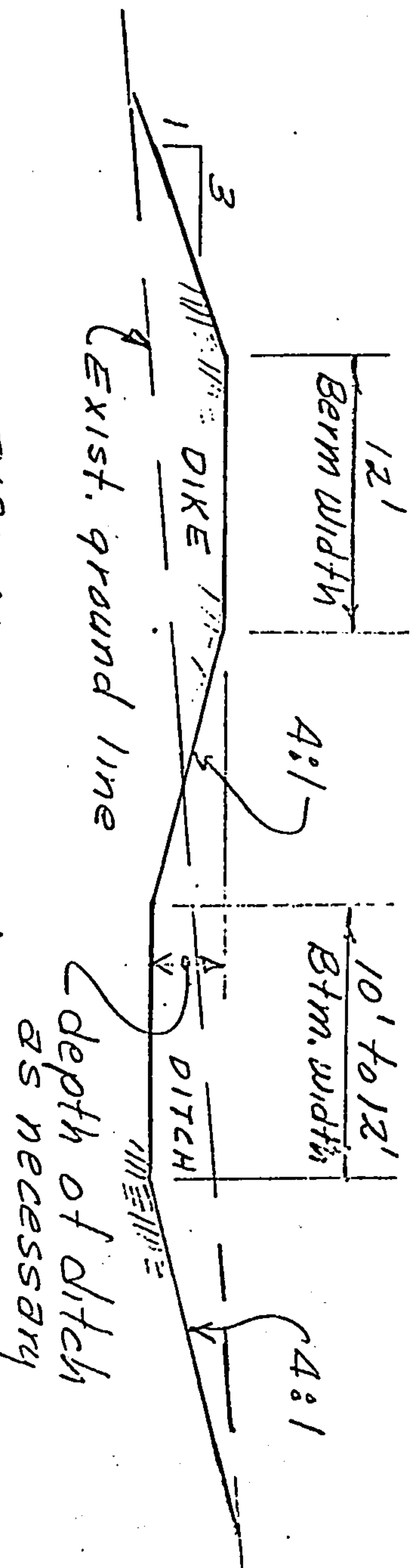
Project FOUR HILLS VILLAGE Sheet 25 of 30
19TH INSTALLMENT Job No. 130
By J.M. Chkd ✓ Date 11-29-73

FACILITY DESIGN

FOUR HILLS DIVERSION DITCH

Design Concept

1. Earth channel
2. low velocities - flat slope -
3. Provide relatively flat side slopes on ditch to enhance vegetation growth & to minimize erosion.



TYPICAL SECTION

Ditch flows @ various depths - (d)

Use ditch flowline grade of 0.25%

Use $n = 0.030$

$d = 1.0 \text{ ft.}$ 10' bottom width of ditch

$$V = \frac{1.486}{n} R^{2/3} S^{1/2} = \frac{1.486}{0.030} (R^{2/3}) (0.0025)^{1/2}$$

$$V = 49.53 (R)^{2/3} (0.05). \quad R = \frac{A}{WP} = \frac{14}{18.24} \cdot R^2$$

$$V = 49.53 (0.84) (0.05) = 2.08 \quad Q = 2.08 \times 14 = \underline{29.125}$$

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Project FOUR HILLS VILLAGE Sheet 24 of 30
19TH INSTALLMENT Job No. 130
By JH Chkd — Date 11-29-78

FACILITY DESIGN

FOUR HILLS DIVERSION DITCH

TABULATION - DITCH FLOW RATES Ditch Grade = 0.25%

Ditch Estm. width	Depth of flow - FT.	Velocity FPS	Q CFS
10'	1.0'	2.08	29.1
10'	1.5'	2.60	62.3
12'	1.0'	2.12	33.9
12'	1.25'	2.40	51.0
12'	1.5'	2.65	71.6
12'	2.0	3.10	124.0
12'	2.5'	3.51	193.0
12'	3.0'	3.88	279.2
12'	3.5'	4.22	384.3
12'	4.0'	4.55	509.5
Ditch Grade = 0.30%			
12'	2.5	3.84	211.2
12'	3.0	4.25	306.0
12'	3.5	4.62	420.4

NOTE: Provide desilting basins @ entrance
of larger flow to the diversion ditch.

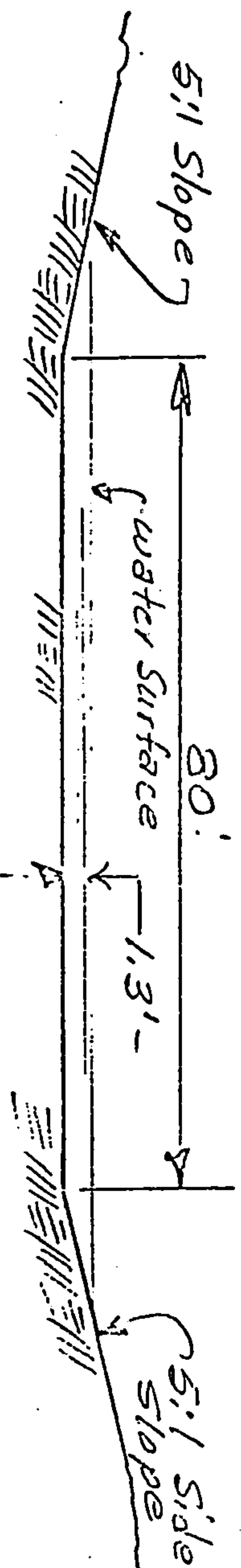
FACILITY DESIGN

FOUR HILLS ARROYO

Existing Arroyo Channel Characteristics

Required Capacity - Upstream of Wapiti
= 1316 CFS - See Sheet 20

Average width of Channel = 80'
Average Channel side slope = 5:1
Average - Slope of Flowline = 5.3%



Use depth of water = 1.3 ft, $n = 0.030$

$$\text{Area} = 1.3 \times 80 + 1.3 \times 6.5 = 112.5 \text{ ft}^2$$

$$\text{WP} = 93.25' \quad R = \frac{112.5}{93.25} = 1.206$$

$$V = \frac{1.486}{n} R^{2/3} S^{1/2} = \frac{1.486}{0.030} (1.133)^{2/3} (0.23)^{1/2}$$

$$V = 12.9 \text{ fps}$$

$$Q = AV = 112.5 \times 12.9 = 1451 \text{ CFS} \quad \text{OK}$$

depth of flow will average
slightly less than 1.3 ft.

NOTES

Provide bank protection @ sides of
arroyo to maintain straight & even flow.

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Project FOUR HILLS WILLMER Sheet 26 of 30
19TH INSTALLMENT Job No. 130
By JA Chkd U Date 11-29-73

FACILITY DESIGN

FOUR HILLS ARROYO

DRAINAGE STRUCTURE -

Four Hills Arroyo @ Wagontrain Drive

From previous sheet - Channel
entrance velocity = 12.9 cfs

Required - Opening Area of Structure
$$= \frac{1316 \text{ cfs}}{12.9} = 102 \text{ ft}^2$$

Use 5 - 60" RCP.

Open Area = $2.5^2 \pi \times 5 = 98.17 \text{ ft}^2$

NOTES

1. Design inlet of structure to increase velocity slightly.
2. Provide channel erosion protection upstream & downstream of structure.

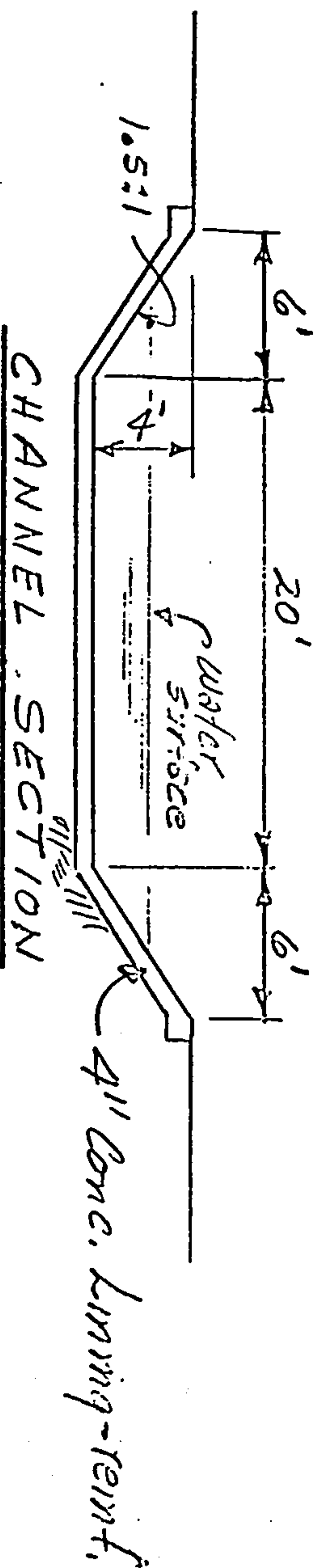
FACILITY DESIGN

FOUR HILLS AIRPORT

Concrete lined Channel

Required Capacity @ Inlet = 1334 CFS
(see sheet 21)

Design channel for 1461 CFS - (see sheet 21)
\$ for 1538 CFS - (see sheet 22)



Assume channel slope = 4.20% min.
depth water = 2.2 ft. $n = 0.015$

$$\text{Area} = 2.2 \times 20 + 2.2 \times 3.3 = 51.26 \text{ ft}^2$$

$$WP = 27.93 \quad R = \frac{51.26}{27.93} = 1.835$$

$$V = \frac{1.486}{n} R^{2/3} S^{1/2} = \frac{1.486}{0.015} (1.835)^{2/3} (.205)^{1/2}$$

$$V = 30.44 \text{ fps}$$

$$Q = AV = 51.26 \times 30.44 = 1560 \text{ CFS} - \text{OK}$$

$> 1461 \text{ } \$ 1538$

NOTES

1. Provide erosion protection @ inlet to conc. lining
2. Provide transition structure @ end of concrete lining & entrance to triple box constructed by city.

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Project East Hills Well Field Sheet 22 of 30
19th Installment Job No. 130
By MA Chkd — Date 11-22-73

FACILITY DESIGN

Camino Cerito @ Caballero Drive

$Q = 164$ CFS. See Sheet 17

This flow exceeds capacity of existing street.

Solution: Remove existing paving from north boardwalk of the 19th Installment north to Speakman Drive. Replace with inverted crown street.

Capacity of Inverted Crown street

" $n = 0.015$ Slope = 0.60%

Area = $28 \times 17 + 32 \times 0.67 = 26.2 \text{ ft}^2$

$WP = 33.3$

$R = \left(\frac{26.2}{33.3} \right)^{2/3} = 0.852$

$V = \frac{1.486}{0.015} (1.852)(1.006)^{1/2} = 6.54$

$Q = 26.2 \times 6.54 = 171.3 \text{ CFS} > 164 \text{ CFS}$

NOTE Under high flows in Camino Cerito there will be some spill over the water block on Speakman Drive as the water block is only 4" high. This will provide some reduction in flow on Camino Cerito.

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Project FOUR HILLS VILLAGE Sheet 29 of 30
19TH INSTALLMENT Job No. 150
By MM Chkd — Date 11-29-73

FACILITY DESIGN

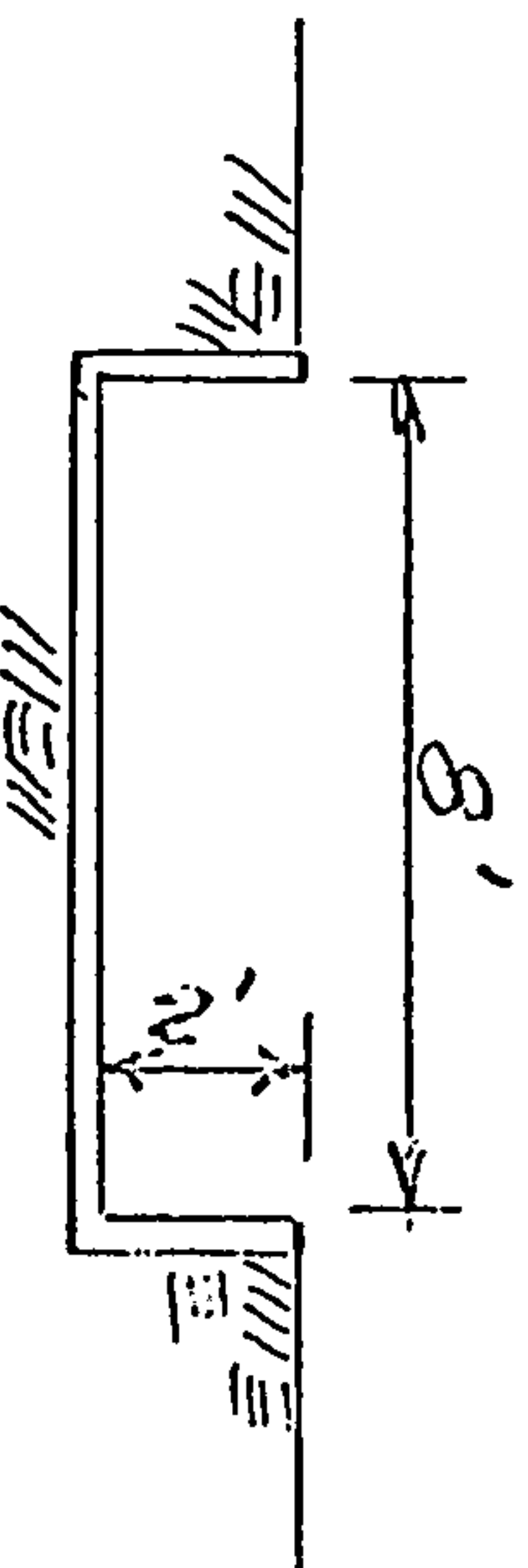
Drainage Easement Channel

Lots 43 & 44 - Block 17-A &

Outlet Channel - Camino Cerro & Caballero Dr.

$$Q = 169.7 \text{ CFS}$$

Use concrete channel @ 2% grade



$$\text{depth of flow} = 1.5' \quad n = 0.015$$

$$V = \frac{1.486}{0.015} \times \left(\frac{12}{11}\right)^{2/3} (1.02)^{1/2} = 14.84 \text{ ft/sec}$$

$$Q = AV = (1.5 \times 8) (14.84) = \underline{178 \text{ CFS}} \quad \text{OK}$$

> 169.7-

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Project FOUNTAIN HILLS VILLAGE Sheet 30 of 30
1977 EASEMENT Job No. 130
By JH Chkd ✓ Date 11-29-73

FACILITY DESIGN

Conestoga Drive Cul de Sac.

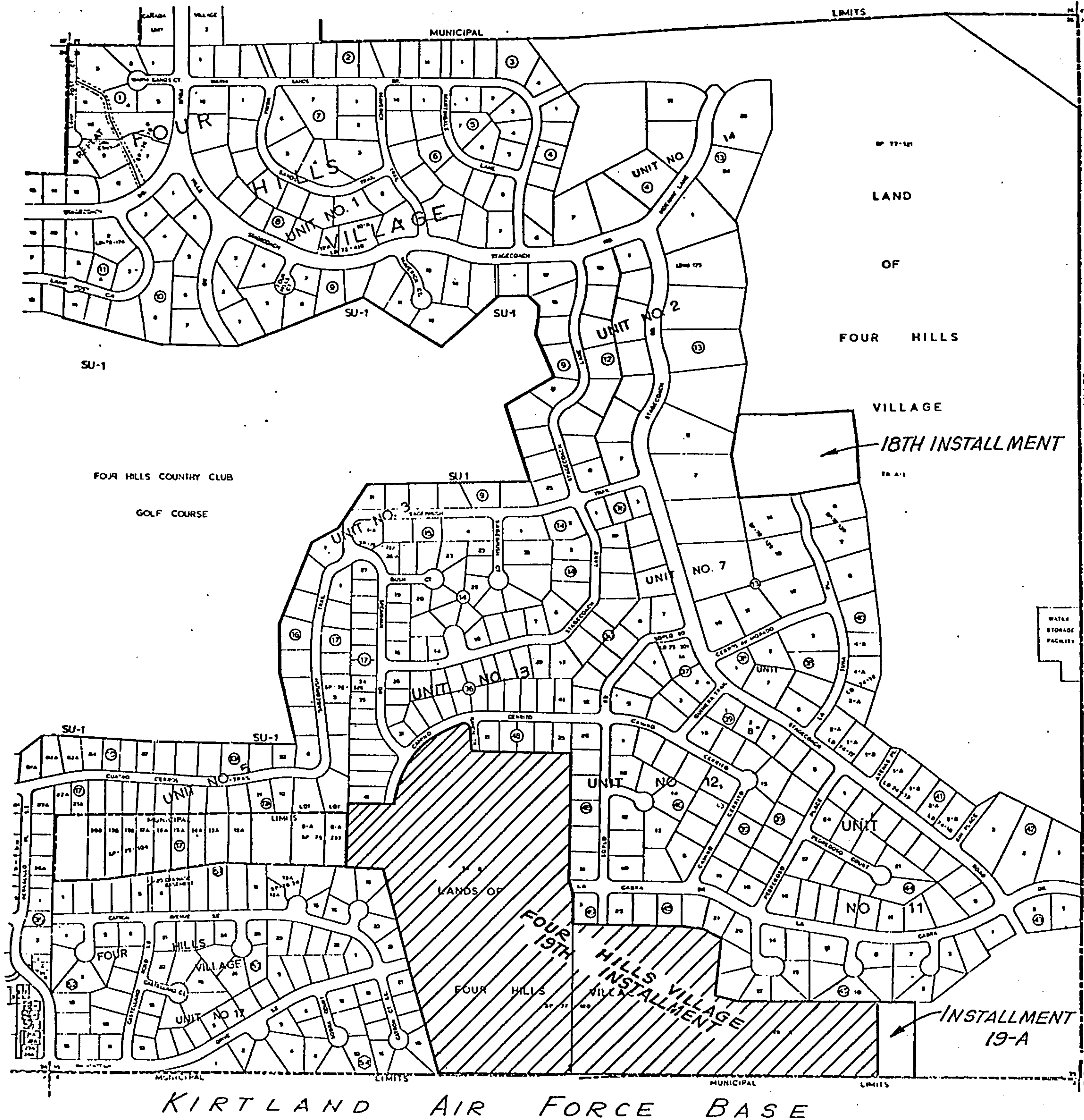
Drainage Easement Storm Sewer
LOTS 39 & 40, Block 54. A

$Q = 8.8 \text{ cfs}$ See Sheet 19

Use - 1- Drop Inlet, Double "C"

Use - 18" RCP outfall line @ 1.6%

Capacity = 12 cfs OK
8.8



FOUR HILLS VILL.
19TH INSTALLMENT
DRAINAGE ANALYSIS

LEGAL DESCRIPTION
T 10 N
R 4 E
SEC 20

UNIFORM PROPERTY CODE
P-88-003

MAP AMENDED THROUGH
APRIL 1978

LOCATION MAP

M-23-Z

ALBUQUERQUE PLANNING DEPARTMENT

MAP NO. 1

