PUBLIC WORKS/HYDROLOGY

G20/D8

0000 0000 1005

G20/D8

25×10

0000 0000 1006

City of Albuquerque

P.O. BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

KEN SCHULTZ
MAYOR

December 6, 1988

Ramon, Please get a copy of this Drainage Covenant
Thanks
Glenn

Dennis A. Lorenz, P.E.
Espey, Huston, & Associates, Inc.
317 Commercial Street, NE
Albuquerque, NM 87102

RE: DRAINAGE REPORT SUBMITTAL FOR VILLAGE APARTMENTS, RECEIVED NOVEMBER 15, 1988, FOR FINAL PLAT AND GRADING PERMIT APPROVAL. (G20/D8)

Dear Mr. Lorenz:

The above referenced submittal, revised 11/30/88, is approved. The owner is not approved to proceed with the construction however until the following items are accomplished:

1. A **Drainage Covenant** must be executed between the owner and the City where the owner is responsible for construction and maintenance of the improvements within the public drainage easements in accordance with the approved Plan.

2. The S.O.# 19 process is followed and the contractor has obtained an Excavation Permit for reconstruction and inspection of the block wall at the east end of the north swale.

Prior to any vacation approval of the existing drainage easements, the drainage improvements must be constructed and certified by an Engineer that they have been constructed in accordance with the approved Plans. A vacation action will require a replat of Unit 4, La Sala Grande, with dedication of Public drainage easements meeting requirements of the approved Plan.

The Drainage Covenant should be submitted to this office for review and processing. Example covenant forms can be obtained from this office or from the Design Review Section.

If you have any questions call me at 768-2650.

Cordially;

Roger A. Green, PE

Roger A. Green, P.E.
C.E./ Hydrology Section

xc: Wm. Gupton, CBS Property Services

25×10

0000 0000 1007

FILE COPY

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

KEN SCHULTZ
MAYOR

December 6, 1988

Dennis A. Lorenz, P.E.
Espey, Huston, & Associates, Inc.
317 Commercial Street, NE
Albuquerque, NM 87102

RE: DRAINAGE REPORT SUBMITTAL FOR VILLAGE APARTMENTS, RECEIVED NOVEMBER 15, 1988, FOR FINAL PLAT AND GRADING PERMIT APPROVAL. (G20/D8)

Dear Mr. Lorenz:

The above referenced submittal, revised 11/30/88, is approved. The owner is not approved to proceed with the construction however until the following items are accomplished:

1. A Drainage Covenant must be executed between the owner and the City where the owner is responsible for construction and maintenance of the improvements within the public drainage easements in accordance with the approved Plan.

2. The S.O.# 19 process is followed and the contractor has obtained an Excavation Permit for reconstruction and inspection of the block wall at the east end of the north swale.

Prior to any vacation approval of the existing drainage easements, the drainage improvements must be constructed and certified by an Engineer that they have been constructed in accordance with the approved Plans. A vacation action will require a replat of Unit 4, La Sala Grande, with dedication of Public drainage easements meeting requirements of the approved Plan.

The Drainage Covenant should be submitted to this office for review and processing. Example covenant forms can be obtained from this office or from the Design Review Section.

If you have any questions call me at 768-2650.

Cordially;

Roger A. Green, P.E.

Roger A. Green, P.E.
C.E./ Hydrology Section

xc: Wm. Gupton, CBS Property Services

25×10

0000 0000 1008

DRAINAGE INFORMATION SHEET

PROJECT TITLE: VILLAGE APARTMENTS ZONE ATLAS/DRNG. FILE #: G20/D8

LEGAL DESCRIPTION: LOTS 1 & 2, LA SALA GRANDE ADDN, UNIT 4

CITY ADDRESS: 3400 WYOMING BLVD NE

ENGINEERING FIRM: ESPEY HUSTON CONTACT: D. LORENZ

ADDRESS: 317 COMMERCIAL ST NE PHONE: 242 1909

OWNER: CBS PROPERTY SERVICES CONTACT: WM. GUPTON

ADDRESS: 6400 UPTOWN PHONE: 883-6410

ARCHITECT: NA CONTACT:

ADDRESS: PHONE:

SURVEYOR: ESPEY HUSTON CONTACT: TIM ALDRICH

ADDRESS: SAME PHONE:

CONTRACTOR: NA CONTACT:

ADDRESS: PHONE:

PRE-DESIGN MEETING:

X YES

___ NO

___ COPY OF CONFERENCE RECAP SHEET PROVIDED

RECEIVED DEC 02 1988 HYDROLOGY SECTION

DRB NO. ___

EPC NO. ___

PROJ. NO. ___

TYPE OF SUBMITTAL:

X DRAINAGE REPORT UPDATE

___ DRAINAGE PLAN

___ CONCEPTUAL GRADING & DRAINAGE PLAN

___ GRADING PLAN

___ EROSION CONTROL PLAN

___ ENGINEER'S CERTIFICATION

ATTN: ROGER GREEN.

CHECK TYPE OF APPROVAL SOUGHT:

___ SKETCH PLAT APPROVAL

___ PRELIMINARY PLAT APPROVAL

___ SITE DEVELOPMENT PLAN APPROVAL

X FINAL PLAT APPROVAL

___ BUILDING PERMIT APPROVAL

___ FOUNDATION PERMIT APPROVAL

___ CERTIFICATE OF OCCUPANCY APPROVAL

___ ROUGH GRADING PERMIT APPROVAL

X GRADING/PAVING PERMIT APPROVAL

X OTHER INFO AS REQUESTED (SPECIFY)

DATE SUBMITTED: NOV 30, 1988

BY: D. LORENZ

25 x 10

0000 0000 1009

DRAINAGE INFORMATION SHEET

PROJECT TITLE: VILLAGE APARTMENTS ZONE ATLAS/DRNG. FILE #: G20/D8

LEGAL DESCRIPTION: LOTS 1 & 2, LA SALA GRANDE ADDN, UNIT 4

CITY ADDRESS: 3400 WYOMING BLVD NE

ENGINEERING FIRM: ESPEY HUSTON CONTACT: D. LORENZ

ADDRESS: 317 COMMERCIAL ST NE PHONE: 242 1909

OWNER: CBS PROPERTY SERVICES CONTACT: WM. GUPTON

ADDRESS: 6400 UPTOWN PHONE: 883-6410

ARCHITECT: NA CONTACT:

ADDRESS: PHONE:

SURVEYOR: ESPEY HUSTON CONTACT: TIM ALDRICH

ADDRESS: SAME PHONE:

CONTRACTOR: NA CONTACT:

ADDRESS: PHONE:

PRE-DESIGN MEETING:

X YES

___ NO

___ COPY OF CONFERENCE RECAP SHEET PROVIDED

WP+934

DRB NO.

EPC NO.

PROJ. NO.

RECEIVED NOV 15 1988 HYDROLOGY SECTION

TYPE OF SUBMITTAL:

X DRAINAGE REPORT UPDATE

___ DRAINAGE PLAN

___ CONCEPTUAL GRADING & DRAINAGE PLAN

___ GRADING PLAN

___ EROSION CONTROL PLAN

___ ENGINEER'S CERTIFICATION

Verbal Comments made 11/28/88, Roger Green

CHECK TYPE OF APPROVAL SOUGHT:

___ SKETCH PLAT APPROVAL

___ PRELIMINARY PLAT APPROVAL

___ SITE DEVELOPMENT PLAN APPROVAL

X FINAL PLAT APPROVAL

___ BUILDING PERMIT APPROVAL

___ FOUNDATION PERMIT APPROVAL

___ CERTIFICATE OF OCCUPANCY APPROVAL

___ ROUGH GRADING PERMIT APPROVAL

X GRADING/PAVING PERMIT APPROVAL

___ OTHER _____ (SPECIFY)

DATE SUBMITTED: NOV 15, 1988

BY: D. LORENZ

25×10

0000 0000 10 10

CITY OF ALBUQUERQUE
MUNICIPAL DEVELOPMENT DEPARTMENT
ENGINEERING DIVISION/DESIGN HYDROLOGY SECTION

CONFERENCE RECAP

DRAINAGE FILE/ZONE ATLAS PAGE NO.: G20-D8 DATE: 9/21/88

PLANNING DIVISION NOS: EPC: _____ DRB: _____

SUBJECT: LA [illegible] Subdivision, Unit 4, Block A, Lots 1-2

STREET ADDRESS (IF KNOWN): _____

SUBDIVISION NAME: Village Apts

APPROVAL REQUESTED:

____	PRELIMINARY PLAT	____	FINAL PLAT
____	SITE DEVELOPMENT PLAN	____	BUILDING PERMIT
✓	OTHER UPDATE DRAINAGE PLAN FOR G20-D8	____	ROUGH GRADING

	WHO	REPRESENTING
ATTENDANCE:	Dennis Lorenz	
	Bill Gordon	
	Fred J. Requena	

FINDINGS:

Recommend that a topographic survey be conducted to address existing conditions as well as effects to off-site flows downstream consistent with onsite flow conditions. The second step would be to schedule a meeting with this office to discuss solutions to the drainage problems.

The undersigned agrees that the above findings are summarized accurately and are only subject to change if further investigation reveals that they are not reasonable or that they are based on inaccurate information.

SIGNED:	Fred Requena	SIGNED:	[illegible]
TITLE:		TITLE:	[illegible]
DATE:	9/21/88	DATE:	9/21/88

NOTE PLEASE PROVIDE A COPY OF THIS RECAP WITH THE DRAINAGE SUBMITTAL

25 x 10

0000 0000 1011

DRAINAGE REPORT UPDATE
FOR
VILLAGE APARTMENTS

RECEIVED
NOV 15 1988
HYDROLOGY SECTION

Prepared by:
Espey, Huston & Associates, Inc.
317 Commercial Street NE
Albuquerque, New Mexico 87102

DENNIS A. LORENZ
NEW MEXICO
8647
REGISTERED PROFESSIONAL ENGINEER

11-11-88

November 1988

25×10

0000 0000 10 12

PURPOSE AND SCOPE

The purpose of this report is to present an Update to the existing Grading and Drainage Report for the Village Apartments prepared by Campbell and Associates, Inc., dated November 1973. The Update outlines criteria for controlling runoff in a manner that is acceptable to the City of Albuquerque and the Albuquerque Metropolitan Arroyo Flood Control Authority.

The scope of the report is to provide analysis of the existing hydrological and hydraulic conditions of the site and effected upstream and downstream properties in order to recommend improvements which will mitigate existing documented drainage problems. Contained in the back pocket of this report are the construction documents which are required to implement the recommendations made by this report.

SITE DESCRIPTION

The site is located on Wyoming Boulevard NE at Comanche Road NE (see vicinity map Figure 1). The site contains approximately 16.7 acres and is presently developed as an apartment complex. Existing topography slopes from east to west at approximately 3 percent. Onsite soils consist mainly of Embudo type soils and are classified by the Soil Conservation Service as being in hydrologic soil group "B".

EXISTING DRAINAGE CONDITIONS

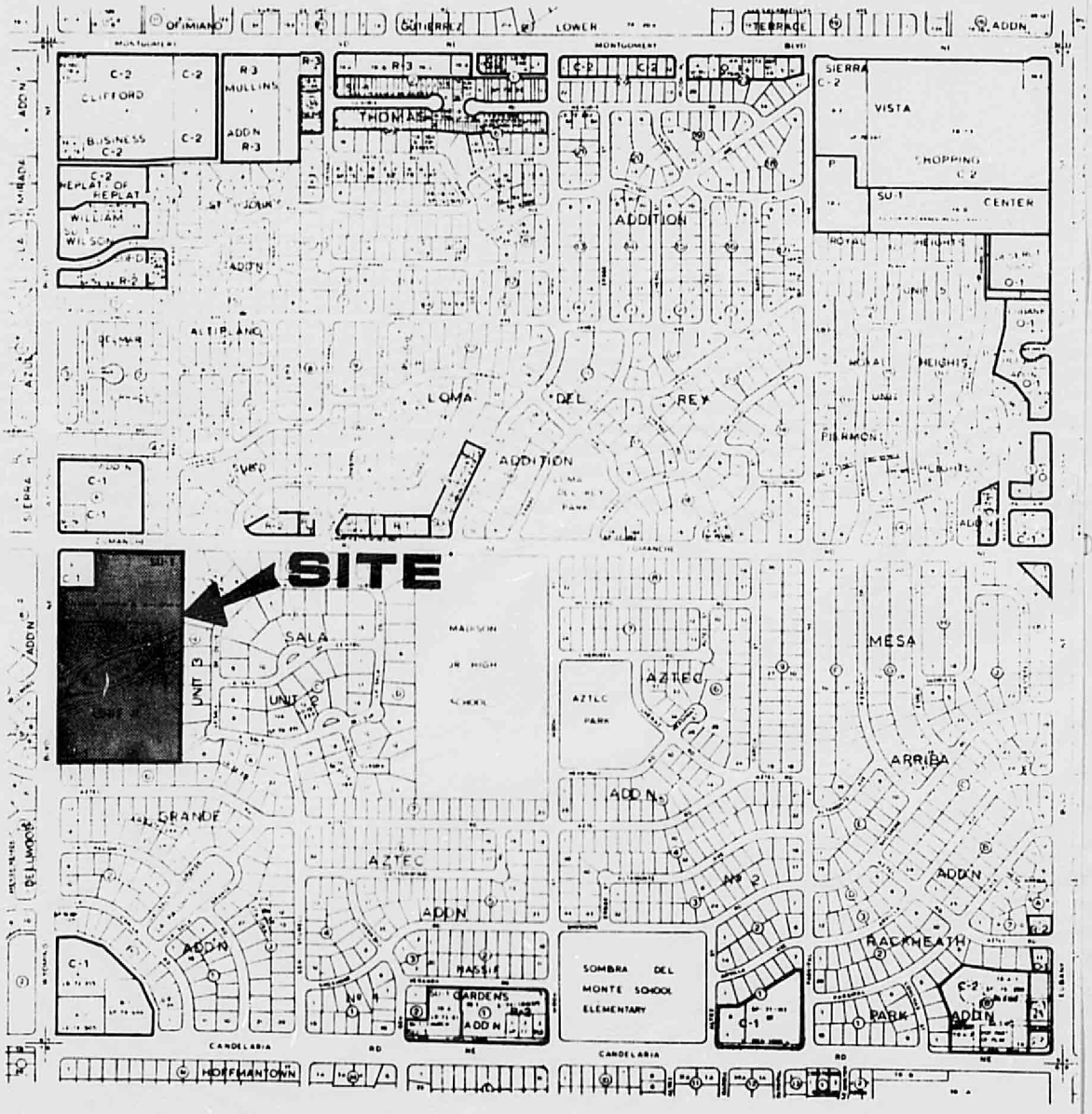
The site is characterized by two major drainage features that accept and convey offsite flows from the east. In each case, problems exist that require correction to mitigate the flooding of private property. The northern feature is a landscaped swale that accepts flows from a 21 acre offsite basin as well as 8.4 acres onsite. At the east boundary of the site, flows pass through a slump block wall that was constructed with 2 sump type inlets in the wall footing. Once onsite, flows are conveyed by a sod lined swale to a 36 inch CMP culvert at a road crossing, under a pedestrian foot bridge, and on to Wyoming Blvd. At Wyoming the flows contribute to an existing flood hazard zone which is drained by a storm drain system.

The southern feature is a paved parking lot swale that accepts flows from a 33 acre offsite basin as well as 8.3 acres onsite. At the east boundary of the site, flows enter the property through an 8"x 20' opening in an existing slump block wall. Once onsite, the flows are conveyed by the swale to an existing detention pond located along Wyoming. The pond drains by 2-3 inch drainlines into Wyoming where the flows are intercepted by an existing storm drain system.

Both swales where analyzed to determine how the existing

25×

0000 0000 1013



VICINITY MAP

G-20

1"=800'

FIGURE 1

25×10

0000 0000 1014

facilities were functioning during the 100 year storm event. Water surface profiles were determined by utilizing HEC II modelling techniques. The analysis determined that failures exist that require corrective measures. The northern swale has 3 noted failures: 1) the inlet at the block wall is undersized, resulting in backwater damage to upstream properties; 2) the 36 inch CMP can not drain the design storm which causes water to top the road crossing; and 3) the swale outfall at Wyoming allows flows to top the sidewalk in a sheet flow manner, perpendicular to the traffic flow.

The south swale functions well through the parking lot, but the detention pond is small and is not provided with an overflow spillway. This condition causes backwater into the parking lot resulting in pavement damage, and without a spillway excess flows drain over landscaping improvements and sidewalks in an uncontrolled manner.

Figure 2 is presented to illustrate the offsite drainage basins affecting the site and show the proximity of the site to the flood hazard zone located in Wyoming Blvd.

PROPOSED DRAINAGE CONDITIONS

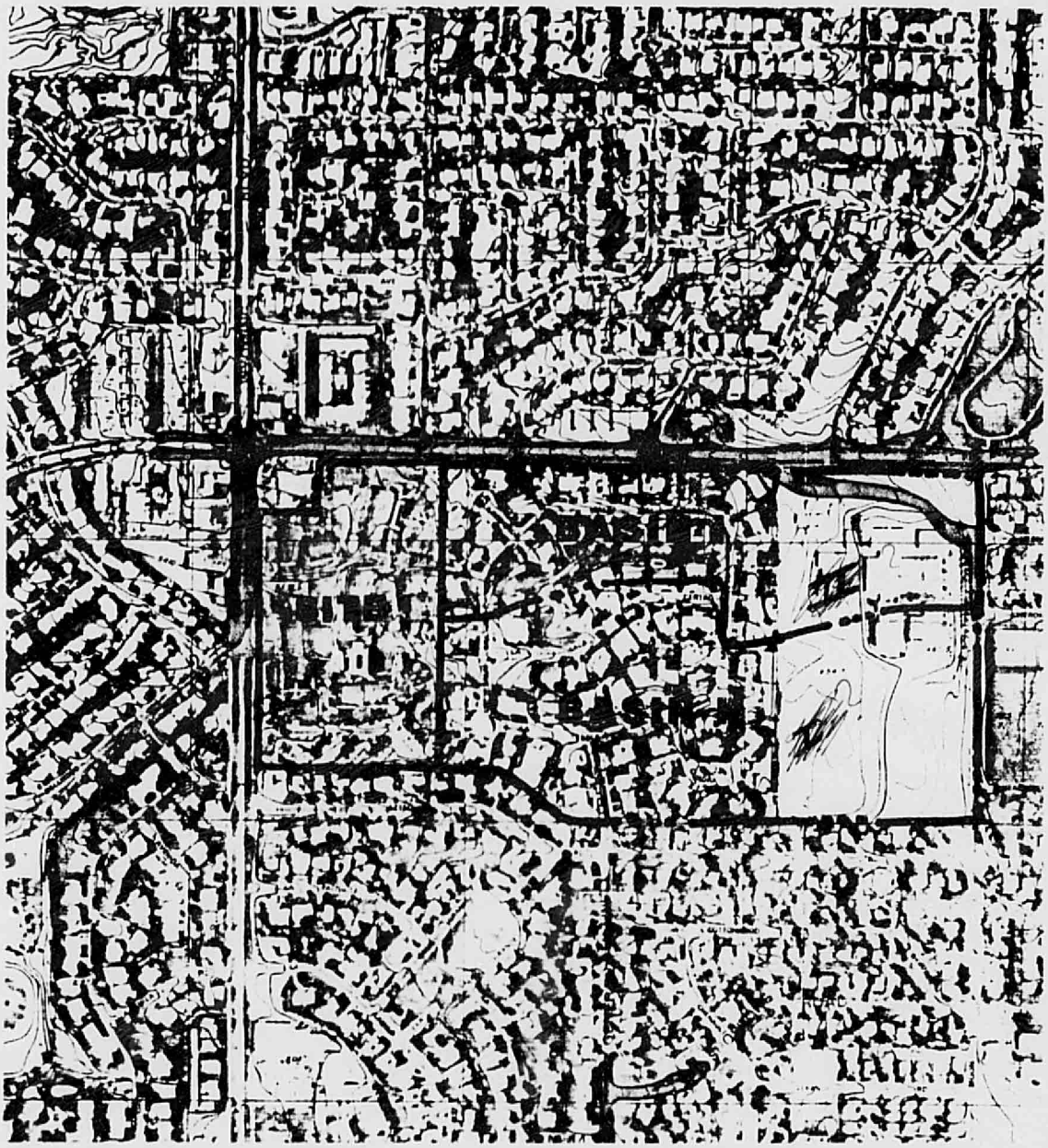
As stated in the previous section, corrective measures are required to mitigate drainage problems which could pose a hazard to health and safety. Since the existing improvements are located within public drainage easements, any corrective measures will require City approval. However, due to the circumstances (the owner has voluntarily agreed to improve conditions, not as a result of any pending platting or site plan approval) the City Hydrologist has agreed to work with the owner to improve conditions without holding to the letter of the Development Process Manual. The owner has also agreed to replat the property in order to establish revised legal description for the drainage easements which contain the drainage swales.

Improvements to the north swale will consist of reconstructing the block wall at the east property line to allow offsite flows to freely enter the property without causing backwater damage to upstream properties. Two additional 36 inch CMP culverts will be added at the road crossing to ensure that all flows pass under the driving surface. And at Wyoming, an outfall structure will be constructed to pass flows under the sidewalk and turn the flows in a downstream direction to reduce the impact on northbound traffic.

Improvements to the south swale will consist of the construction of an overflow spillway and improving the entrance condition at the detention pond.

25×10

0000 0000 10 15



DRAINAGE BASIN & FHZ MAP

1"=500'

FIGURE 2

25x

0000 0000 10 16

CALCULATIONS

25×10

0000 0000 10 17

CALCULATIONS

I. CRITERIA

Rainfall: P100 = 2.40 in.
P10 = 1.58 in.

Time of Concentration: Tc = 0.0078(L^0.77)/S^0.385 (min.)

where L = length (ft.)
S = slope (ft./ft.)

Soil: Embudo (EmB)
Hydrologic soil group "B"

SCS curve number: CN per DPM, Vol. II, plates 22.2 C2 & C3

Runoff: Q = 45.4AR/Tc (c.f.s.) - SCS Method

where A = basin area (ac.)
R = direct runoff (in.)
Tc = time of conc. (min)

Volume: 3630AR (c.f.) - SCS Method

where A = basin area (ac.)
R = direct runoff (in.)

RECEIVED
DEC 02 1988
HYDROLOGY SECTION

II. RUNOFF

BASIN	AREA	Tc	%IMP	CN	R10	R100	Q10	Q100	V10	V100
A	8.3	19	70	89	0.75	1.40	28.3	52.8	22,597	42,181
B	8.4	25	70	89	0.75	1.40	28.6	53.4	22,869	42,689
* I	21.0	10	43	82	0.40	1.00	38.1	95.3	30,492	76,230
* II	33.0	13	43	82	0.40	1.00	46.1	115.2	47,916	119,790
* A+II	41.3	18	47	83	0.45	1.10	46.9	114.6	67,464	164,911
* B+I	29.4	13	51	84	0.50	1.15	51.3	118.1	53,361	122,730

* Revised 11-30-88

25×10

0000 0000 10 18

CALCULATIONS

I. CRITERIA

Rainfall: P100 = 2.40 in.
P10 = 1.58 in.

Time of Concentration: Tc = 0.0078(L^0.77)/S^0.385 (min.)

where L = length (ft.)
S = slope (ft./ft.)

Soil: Embudo (EmB)
Hydrologic soil group "B"

SCS curve number: CN per DPM, Vol. II, plates 22.2 C2 & C3

Runoff: Q = 45.4AR/Tc (c.f.s.) - SCS Method

where A = basin area (ac.)
R = direct runoff (in.)
Tc = time of conc. (min)

Volume: 3630AR (c.f.) - SCS Method

where A = basin area (ac.)
R = direct runoff (in.)

II. RUNOFF

BASIN	AREA	Tc	%IMP	CN	R10	R100	Q10	Q100	V10	V100
A	8.3	19	70	89	0.75	1.40	28.3	52.8	22,597	42,181
B	8.4	25	70	89	0.75	1.40	28.6	53.4	22,869	42,689
I	33.0	13	43	82	0.40	1.00	46.1	115.2	47,916	119,790
II	21.0	10	43	82	0.40	1.00	38.1	95.3	30,492	76,230
A+I	41.3	18	47	83	0.45	1.10	46.9	114.6	67,464	164,911
B+II	29.4	13	51	84	0.50	1.15	51.3	118.1	53,361	122,730

Fully Developed watershed ?

25×10

0000 0000 10 19

PROJECT NAME VILLAGE APARTMENTS JOB NO. 11418
SUBJECT
BY DL CK. BY APPROVED BY DATE 11-11-88 PAGE 2 OF 7
△1 REVISED 11-30-88

III. IMPROVEMENT DESIGN CALCULATIONS.

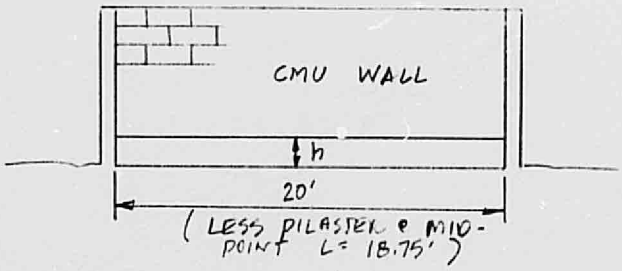
A. NORTH SWALE

1. REDESIGN INLET AT WALL (EAST PL)

$Q_{100} = 118$ CFS. △1

FLOW IS CHANNELIZED UPSTREAM WITHIN STREET TYPE SECTION 20' FF

FIND DEPTH REQ'D FOR RECTANGULAR INLET AT BASE OF WALL:



RECEIVED DEC 02 1988 HYDROLOGY SECTION

USE MANNING'S EQN, SOLVE FOR h:

$Q = 118$ cfs
$n = 0.017$
$A = 18.75\,h$
$P = 18.75 + 2h$
$S = 0.034$

$$118 = \frac{1.49}{0.017} AR^{2/3}(0.034)^{1/2}$$

$$AR^{2/3} = 7.3$$

$h = 0.57'$ MIN △1
⇒ 0.75 PROVIDED PER PLAN

NOTES:

ESPEY, HUSTON & ASSOCIATES, INC.
Engineering & Environmental Consultants

25×10

PROJECT NAME VILLAGE APARTMENTS. JOB NO. 11418
SUBJECT
BY DL CK. BY APPROVED BY RLS DATE 11-11-88 PAGE 2 OF 7

III. IMPROVEMENT DESIGN CALCULATIONS.

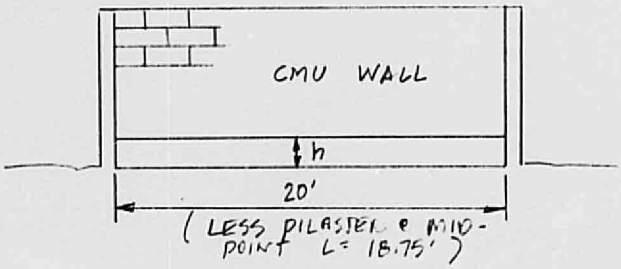
A. NORTH SWALE

1. REDESIGN INLET AT WALL (EAST PL)

$Q_{100} = 115$ CFS.

FLOW IS CHANNELIZED UPSTREAM WITHIN STREET TYPE SECTION 20' FF

FIND DEPTH REQ'D FOR RECTANGULAR INLET AT BASE OF WALL:



USE MANNINGS EQN, SOLVE FOR h:

$Q = 115$ CFS
$n = 0.017$
$A = 18.75\,h$
$P = 18.75 + 2h$
$S = 0.034$

$$115 = \frac{1.49}{0.017} AR^{2/3} (0.034)^{1/2}$$

$$AR^{2/3} = 7.1$$

$h = 0.55'$ MIN.
$\Rightarrow$ 0.75 PROVIDED PER PLAN

NOTES:

ESPEY, HUSTON & ASSOCIATES, INC.
Engineering & Environmental Consultants

25×10

0000 0000 1021

PROJECT NAME VILLAGE APARTMENTS JOB NO. 11418
SUBJECT
BY DL CK. BY APPROVED BY DATE 11-11-88 PAGE 3 OF 7
1 REVISED 11-30-88

2. CMP AT ACCESS ROAD
ADD ADDITIONAL CMPS TO PASS FLOW UNDER PAVEMENT:

1 Q = 118 CFS

USE FIGURE 4-28, "HANDBOOK OF STEEL DRAINAGE & HIGHWAY CONSTRUCTION PRODUCTS", 1983 (ATTACHED)

USE 36" CMP

H_{MAX} = 21.0 (TOP ROAD) − 16.67 (INV) = 4.33'

HW/D = 1.44

PER NOMOGRAPH Q_{MAX} = 48 CFS ±

NO. PIPES = 118 CFS / 48 CFS = 2.5 USE 3
NEED 2 ADD'L 36" CMPS

RECEIVED DEC 02 1988 HYDROLOGY SECTION

3. OUTFALL AT WYOMING
DESIGN CHANNEL SECTION WITH S/W CULVERT AT WYOMING TO PASS Q100:

A. ASPHALT SECTION
RECONSTRUCT ASPHALT PARKING LOT TO PROVIDE CAPACITY. PROVIDE CONCRETE V.G FOR NUISANCE FLOWS:

NOTES:

ESPEY, HUSTON & ASSOCIATES, INC.
Engineering & Environmental Consultants

25×10

PROJECT NAME VILLAGE APARTMENTS JOB NO. 11418
SUBJECT
BY DL CK. BY [illegible] APPROVED BY DATE 11-11-88 PAGE 3 OF 7

2. CMP AT ACCESS ROAD
ADD ADDITIONAL CMPS TO PASS FLOW UNDER PAVEMENT:

Q = 115 CFS

USE FIGURE 4-28, "HANDBOOK OF STEEL DRAINAGE & HIGHWAY CONSTRUCTION PRODUCTS", 1983 (ATTACHED)

USE 36" CMP

H_{MAX} = 21.0 (TOP ROAD) − 16.67 (INV) = 4.33'

HW/D = 1.44

PER NOMOGRAPH Q_{MAX} = 48 CFS ±

NO. PIPES = 115 CFS / 48 CFS = 2.4 USE 3
NEED 2 ADD'L 36" CMPS ✓

3. OUTFALL AT WYOMING
DESIGN CHANNEL SECTION WITH S/W CULVERT AT WYOMING TO PASS Q100:

A. ASPHALT SECTION
RECONSTRUCT ASPHALT PARKING LOT TO PROVIDE CAPACITY. PROVIDE CONCRETE V.G FOR NUISANCE FLOWS:

NOTES:

ESPEY, HUSTON & ASSOCIATES, INC.
Engineering & Environmental Consultants

25×

0000 0000 1023

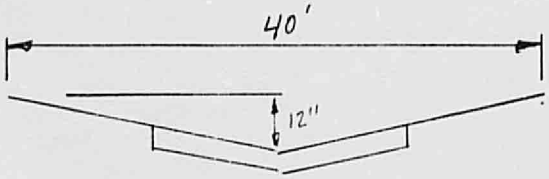
PROJECT NAME VILLAGE APARTMENTS JOB NO. 11418

SUBJECT

BY DL CK. BY APPROVED BY DATE 11-11-88 PAGE 4 OF 7

△1 REVISED 11-30-88

Q_{100} = 118 CFS △1 PROVIDE TRIANGULAR SWALE

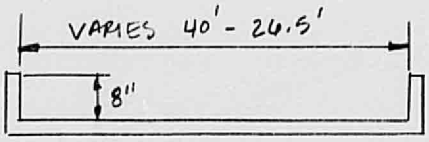


BY MANNINGS EQN:

$n = 0.017$
$A = 20\,SF$
$P = 40\,FT$ ±
$S = 0.024$

Q_{MAX} = 171 CFS > Q_{100} ✓

2. PROVIDE RECT. CHANNEL FOR TRANSITION TO SW CULVERT:



RECEIVED
DEC 02 1988
HYDROLOGY SECTION

USE MANNINGS EQN:

$n = 0.013$
$S = 0.024$
$A = 17.75\,SF$ (@ L=26.5')
$P = 27.9\,FT$

Q_{MAX} = 233 CFS > Q_{100} ✓

NOTES:

ESPEY, HUSTON & ASSOCIATES, INC.
Engineering & Environmental Consultants

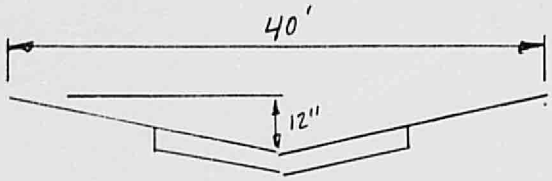
25×10

PROJECT NAME VILLAGE APARTMENTS JOB NO. 11418

SUBJECT

BY DL CK. BY RDS APPROVED BY [illegible] DATE 11-11-88 PAGE 4 OF 7

Q_{100} = 115 CFS PROVIDE TRIANGULAR SWALE

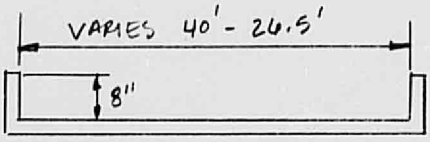


BY MANNINGS EQN:

Q_{MAX} = 171 CFS > Q_{100} ✓

n = 0.017
A = 20 SF
P = 40 FT ±
S = 0.024

2. PROVIDE RECT. CHANNEL FOR TRANSITION TO SW CULVERT:



USE MANNINGS EQN:

Q_{MAX} = 233 CFS > Q_{100} ✓

n = 0.013
S = 0.024
A = 17.75 SF (@ L=26.5')
P = 27.9 FT

NOTES:

ESPEY, HUSTON & ASSOCIATES, INC.
Engineering & Environmental Consultants

25×

0000 0000 1025

PROJECT NAME VILLAGE APARTMENTS JOB NO. 11418
SUBJECT
BY DC CK. BY APPROVED BY DATE 11-11-88 PAGE 5 OF 7
△1 REVISED 11-30-88

3. DESIGN SW CULVERTS @ WYOMING.
ORIENT @ 45° TO CURBLINE TO
POINT FLOW DOWNSTREAM

USE 24" CULVERTS. FIND NO. REQUIRED:
BY MANNINGS EQN:

Q = 118 CFS △1
S = 0.024
A = 0.67 L
P = L + 1.34'
n = 0.013

BY T & E L = 14' ±
USE 7-24" CULVERTS

RECEIVED
DEC 02 1988
HYDROLOGY SECTION

FLOW DISCHARGES INTO EXISTING FH2
WITHIN WYOMING R.O.W.

B. SOUTH SWALE

1. CHECK SWALE ENTRANCE CONDITION
TO EXISTING POND ALONG WYOMING:

Q_{100} = 115 CFS. △1

2. ENTRANCES EXIST FOR A TOTAL
LENGTH OF 25' ±, 6" HIGH (CURB CUTS)

NOTES:

ESPEY, HUSTON & ASSOCIATES, INC.
Engineering & Environmental Consultants

25×10

0000 0000 1026

PROJECT NAME VILLAGE APARTMENTS JOB NO. 11418
SUBJECT
BY DC CK. BY RSS APPROVED BY DATE 11-11-88 PAGE 5 OF 7

3. DESIGN SW CULVERTS @ WYOMING. ORIENT @ 45° TO CURBLINE TO POINT FLOW DOWNSTREAM

USE 24" CULVERTS. FIND NO. REQUIRED:

BY MANNINGS EQN:

$Q = 115$ CFS
$S = 0.024$
$A = 0.67\,L$
$P = L + 1.34'$
$n = 0.013$

BY T & E $L = 14' \pm$
USE 7-24" CULVERTS

FLOW DISCHARGES INTO EXISTING FH2 WITHIN WYOMING R.O.W.

B. SOUTH SWALE

1. CHECK SWALE ENTRANCE CONDITION TO EXISTING POND ALONG WYOMING:

$Q_{100} = 118$ CFS.

2 ENTRANCES EXIST FOR A TOTAL LENGTH OF $25' \pm$, 6" HIGH (CURB CUTS)

NOTES:

ESPEY, HUSTON & ASSOCIATES, INC.
Engineering & Environmental Consultants

25×10

PROJECT NAME VILLAGE APARTMENTS JOB NO. 11418
SUBJECT
BY DL CK. BY RS APPROVED BY DATE 11-11-88 PAGE 4 OF 7

BY WEIR EQN: $L = 25'$, $H = 0.5'$

$Q_{MAX} = 3.33(25)(.5)^{3/2} = 30$ CFS $< Q_{100}$.

ENTRANCE CONDITION CAN NOT BE IMPROVED WITHOUT MAJOR RECONSTRUCTION OF EXISTING IMPROVEMENTS. FLOW WILL TOP CURBS AND ENTER POND WITHOUT DAMAGING ANY BUILDINGS. (SEE PLAN FOR FHZ LIMITS).

2. PROVIDE POND OUTFALL

POND HAS NO OVERFLOW SPILLWAY. FLOWS OVERFLOW EXISTING BERM ALONG WYOMING. PROVIDE OVERFLOW AT NORTH END OF POND.

USE WEIR EQN: $Q = 3.33LH^{3/2}$

MAX L AVAILABLE = 20 FT

USE H = 12" (MAX PRACTICAL)

$Q_{MAX} = 67$ CFS $< Q_{100}$

SOME FLOW WILL CONTINUE TO FLOW OVER BERM ALONG WYOMING. OVERFLOW SPILLWAY WILL DRAIN MOST STORMS.

NOTES:

ESPEY, HUSTON & ASSOCIATES, INC.
Engineering & Environmental Consultants

0000 0000 1028

PROJECT NAME VILLAGE APARTMENTS JOB NO. 11418
SUBJECT
BY DL CK. BY [illegible] APPROVED BY DATE 11-11-88 PAGE 7 OF 7

3. EXISTING POND DRAIN LINES.

CHECK EXISTING 3" PVC DRAINS (2) FOR CAPACITY:

USE ORIFICE EQN FOR INLET CONTROL:

$Q = CA\sqrt{2gh}$ WHERE: $C = 0.6$, $g = 32.2\ F/s^2$, $h = 1.1\ Ft$, $A = 0.1\ SF$

$Q = 0.5\ CFS$

$\Rightarrow$ NO EFFECT ON SPILLWAY CAPACITY

CHECK POND DRAIN TIME:

VOLUME = 3000 CF ±

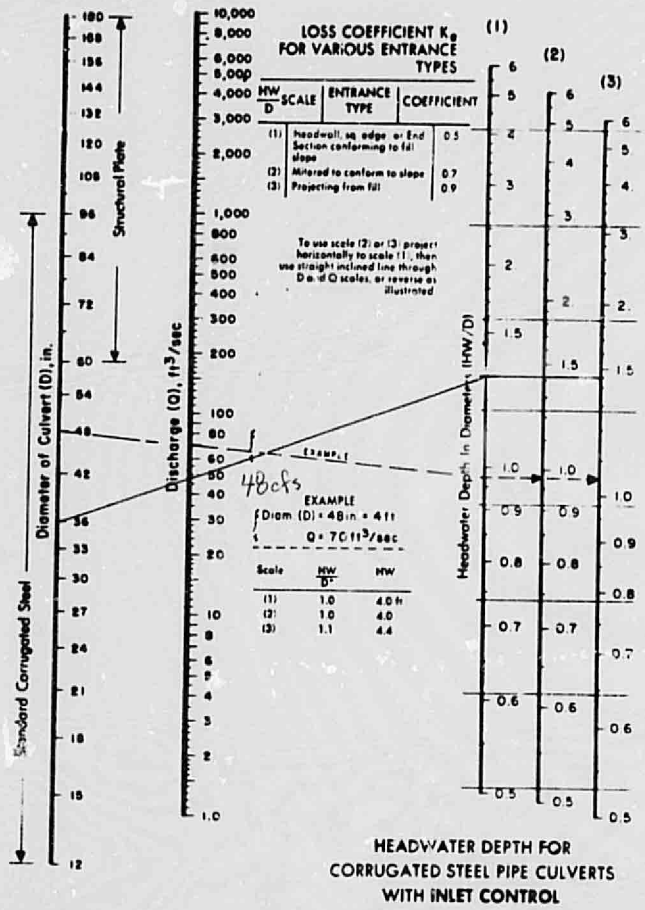
$t = \frac{3000\ CF}{0.5\ CFS} \times \frac{1}{3600} = 2\ hrs \pm$ OK

NOTES:

ESPEY, HUSTON & ASSOCIATES, INC.
Engineering & Environmental Consultants

25×10

0000 0000 1029



HEADWATER DEPTH FOR CORRUGATED STEEL PIPE CULVERTS WITH INLET CONTROL

FHWA HEC 5

Figure 4-28 *Inlet control* nomograph for corrugated steel *pipe* culverts. The manufacturers recommended keeping *HW/D* to a maximum of 1.5 and preferably to no more than 1.0.

25×10

0000 0000 1030

PLANS/PLATS ON FILE

FILE DESC: G20/DS

PLANS/PLATS 3

25 × 10

0000 0000 1031

25×10

HYDROLOGY G20/D8 1 PLAN

G20/D8

1 PLAN

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

DESIGN HYDROLOGY SECTION
123 Central NW, Albuquerque, NM 87102
(505) 766-7644

May 16, 1986

Village Apartments
3400 Wyoming Blvd. NE
Albuquerque, N.M. 87111

TO THE MANAGEMENT:

After investigation of the drainage problem we spoke about several weeks ago, we found that the grate in the wall at the east end of the drainage ditch is the cause of the problem. It appears that the inlet grate is too small to handle all the flows running into it, thereby restricting runoff causing it to back up into the properties adjacent to the drainage right-of-way.

According to the filed plat attached, it appears that your apartment complex is responsible for accepting these offsite flows as there is an easement specified for this purpose.

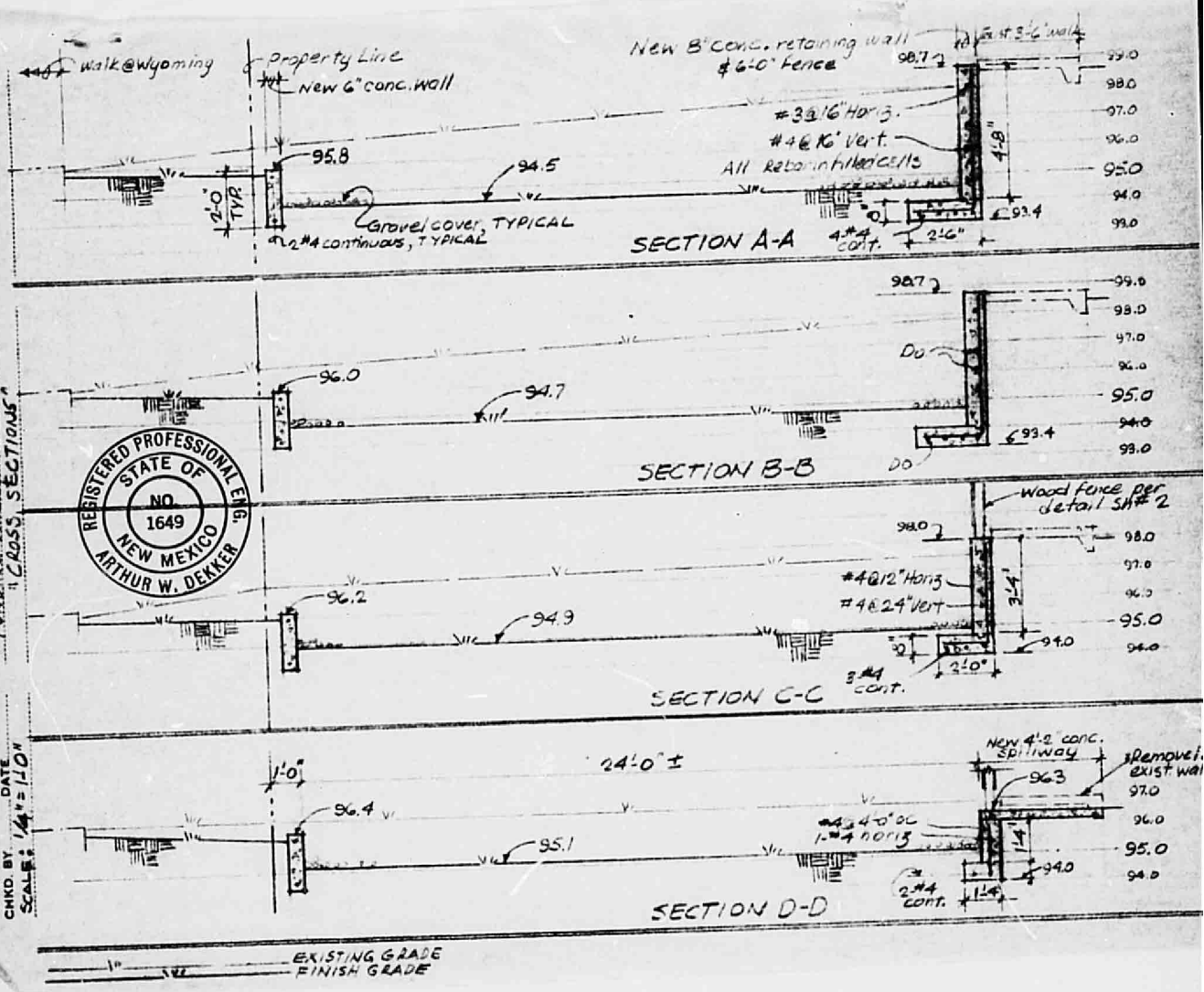
I strongly recommend a registered professional engineer be contracted to update your drainage plan by coming up with a suitable design to alleviate this problem.

If I can be of further assistance, or if I can answer any questions, please feel free to call me at 766-7644.

Sincerely,

Rick L. Duran
Hydrology Inspector

RLD:cl



REGISTERED PROFESSIONAL ENG. STATE OF NEW MEXICO NO. 1649 ARTHUR W. DEKKER

SHEET NO. 1 OF 2
JOB NO. 736.0

SUBJECT VILLAGE APARTMENTS
PONDING AREA SOUTH
"CROSS SECTIONS"

BY AWD DATE 11/13/23
CHKD. BY DATE
SCALE 1/4" = 1'-0"

SHEET NO. 2 OF 2

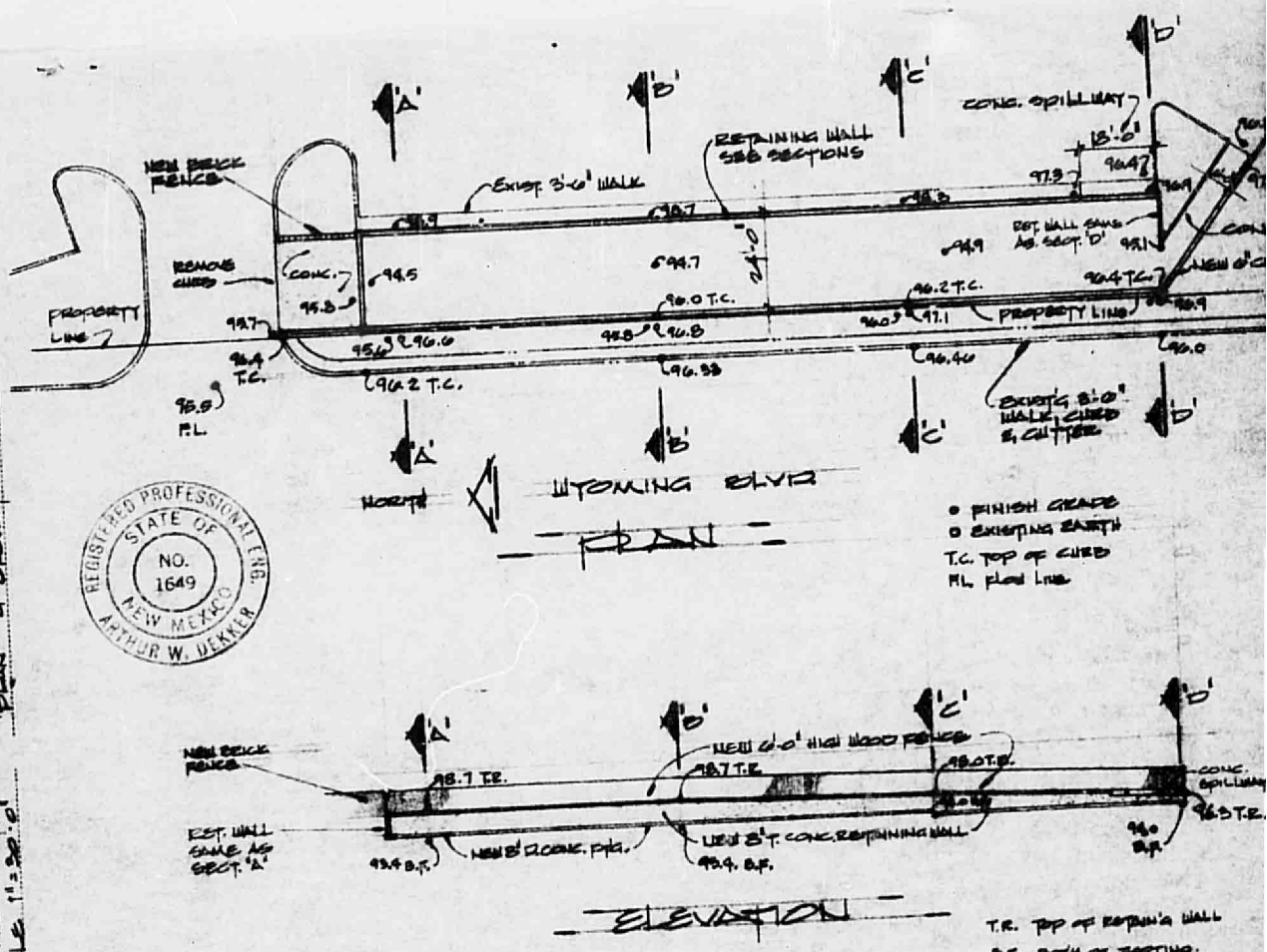
JOB NO. 7302

SUBJECT: VILLAGE APARTMENTS
PARKING AREA SOUTH
PLAN & ELEVATION

BY: L.L.K. DATE 11/12/72

CHKD. BY AVD DATE 11/13/72

SCALE 1" = 20'-0"



PRELIMINARY DRAINAGE STUDY

RELATIVE TO THE DEVELOPMENT OF

VILLAGE APARTMENTS

(LA SALA, UNIT 4)

APPROVED FOR DRAINAGE

14 Nov 73
DATE

G. Kelch
SIGNATURE

ACE
TITLE

CONTINGENCIES

CAMPBELL + HICKS ASSOCIATES, INC.
ALBUQUERQUE, NEW MEXICO

CAMPBELL and ASSOCIATES, Inc.
Soils Testing Laboratory
Consulting Civil Engineers
417 Richmond Dr., S.E. • Phone (505) 268-0274 • Albuquerque, New Mexico 87106

PRELIMINARY DRAINAGE STUDY
RELATIVE TO THE DEVELOPMENT OF
VILLAGE APARTMENTS
(LA SALA, UNIT 4)

NOVEMBER 1973

DRAINAGE STUDY INDEX

DESCRIPTION	PAGE NO.
I. General	1
II. Location	1
III. Existing Drainage Conditions	1
A. General	
B. Topography	
C. Drainage Areas and Channels	
IV. Proposed Drainage Plans	2 - 3
A. General	
B. Drainage Areas	
C. Runoff Quantities	
D. Drainage Channels and Facilities	
V. Conclusions and Recommendations	4 - 5
Exhibits	
A. Location Map	6
B. Plan of Drainage	7
C. Runoff Computations	8 - 10
D. Street Carrying Capacities - Computer Output Sheet	11
E. Drainage Study (by Limbaugh 9/15/71)	12 - 17
Bibliography of References	18

PRELIMINARY DRAINAGE STUDY
RELATIVE TO THE DEVELOPMENT OF
VILLAGE APARTMENTS
(LA SALA, UNIT 4)

I. GENERAL

This report has been prepared to present findings of a study of storm drainage conditions in an area under development as Village Apartments, and to describe a proposed method for providing adequate storm drainage in the area.

II. LOCATION

The area considered in this report is bounded on the west by Wyoming Blvd. NE; on the north by Comanche Road, NE; on the east by La Sala, Unit 3 Subdivision; and on the south by Grande Addition, Block 6, Lots 1 through 8. It is situated mainly in the northwest one-quarter (NW 1/4) of the southwest one-quarter (SW 1/4) of Section 5, Township 10 North, Range 4 East, N.M.P.M.

III. EXISTING DRAINAGE CONDITIONS

A. General

The presently developing area of this subdivision lies about one-half mile east of Madison Jr. High School which contributes runoff to La Sala, Units 2 and 3 just to the east of it. This runoff enters La Sala Subdivision through two drainage easements through Block D to La Sala Del Este and leaving through two similar easements across Block A of Unit 3 to Unit 4.

The runoff conditions and quantities at the eastern boundary of Village Apartments is shown on Exhibit "A", an aerial photograph dated 6/5/71 by Koogle and Pouls Engineering, Inc.

B. Topography

The area of the development is on a wide clinoplain known as the Sandia Mesa, which slopes gradually upward toward the Sandia Mountains at a nearly uniform rate of about 125 feet per mile. This mesa was built by deposits of gravels and clays from the Rio Grande River, intermixed with sand and gravels carried from

the mountains by smaller streams. The mesa is crossed by sandy arroyos or usually dry stream channels which carry large volumes of water runoff for a few hours once or twice each summer.

Arroyo cutting is a problem in the area and has been most acute during the rainy season. Peculiarities of drainage, differences in erodability of the soils, or variation in the density of protective vegetation allows the feeders of one arroyo to cut into and capture the head-of runoff in the second arroyo. Concomintantly, the amount of flow in the first arroyo, the headwaters of which were "pirated"*away, is diminished. This condition has now been arrested by development in in the area.

C. Drainage Areas and Channels

At the present time there are two separate drainage areas contributing runoff from the east. However, there appears to be only one area flowing from east to west that might cause difficulty. This area contributes runoff to the southeast corner of the Village Apartments subdivision.

The runoff from the two drainage areas can be carried by altering planned streets in such a way (set property lines high enough) as to carry water across the development and redepositing it in its original channel.

IV. PROPOSED DRAINAGE PLANS

A. General

In order to provide an adequate system of storm drainage for the proposed development it was necessary to:

(1) Determine the drainage areas which can and will contribute storm runoff during a 100 year design storm.

(2) Determine the amount of runoff which could be expected after the entire area is developed.

(3) Determine the points where the storm runoff will concentrate.

(4) Determine the ability of each of the drainage channels, streets, and structures to handle the runoff that may concentrate on them.

*Reference #1

(5) Determine and recommend the means by which the expected runoff can be safely carried across the subdivision in the same proportion as it now exists.

(6) Design additional channels and structures adequate to handle the runoff in the area to be developed.

B. Drainage Areas

A study of the photography, Exhibit "A", to determine the areas which could conceivably contribute runoff to the proposed development was made, for which a copy of computations is contained in Exhibit "C" of this report. Finally, Exhibit "B", the Plan of Drainage, was prepared showing the entire area with directions of flow as well as runoff quantities.

C. Runoff Quantities

The quantities of storm runoff to be expected from each drainage area were determined using the Rational Formula, Q=CIA, where: Q= quantity of storm runoff in cubic feet per second; C=coefficient of runoff dependent upon the type of surface drained; I=intensity of rainfall in inches per hour for a duration equal to the total accumulation time in minutes; and A=area of contributing watershed in acres.

The area (A) of each separate contributing area was determined by outlining the watershed on a scale photograph or the contour map and measuring the area (by planimeter) in acres.

The intensity of rainfall (I) was determined by assuming a 100 year frequency rainfall and then utilizing Intensity Duration Frequency Curves (Chart I) for the Albuquerque Area, "Master Plan of Drainage-City of Albuquerque, New Mexico and Environs", 1963, prepared by Gordon Herkenhoff and Associates, Consulting Engineers, together with expected accumulation of runoff from each of the areas. The total accumulation times are determined by a combination of Yarnell's Method and probable future streets and drainage channel alignments and grades, as shown; assuming overland flows to cross either poor grass, asphalt pavement or bare soil surfaces, depending upon the probable type of development in each area and estimating the probable type of grading to be done in each area; assuming future streets to be asphalt paved with concrete curbs and crowned with either full crown(8"), 3/4 crown(6"), or 1/2 crown(4").

These times of flow were calculated by use of tables on pages 5.00, 5.04, and 5.05 of Design by E.E.Seelye.

The coefficient of runoff (C) was determined by assuming the maximum possible development in the areas under consideration. A coefficient of 0.65 is used for areas where dense residential development was most probable. A coefficient of 0.70 should be used for apartment areas or where a large amount of the exposed surface is impermeable.

The quantities of runoff are shown along with the areas after development on Exhibit "B", the Plan of Drainage for this subdivision.

D. Drainage Channels and Facilities

All existing structure capacities, as well as any future proposed structured, were verified from computer output sheets which form a part of Exhibit "D" and are based on Manning's Equation, Q=AV, where $V=\frac{1.486}{n} R^{2/3} S^{1/2}$ when A=cross-sectional area of the channel or structure; R=hydraulic radius of channel or area divided by wetted perimeter; S=slope of channel or facility in feet per foot; and "n" values of 0.015 for concrete and asphalt surfaces, 0.013 for concrete pipes, and 0.0225 for dirt lined channels or a composite "n" value based on proportional wetted surfaces with different values.

V. CONCLUSIONS AND RECOMMENDATIONS

On the basis of this study and its calculations, it is concluded that the development of this area has been accomplished satisfactorily provided adequate storm drainage is don as recommended below:

1. The two temporary ponding areas be completed as shown on Exhibit "B".

2. Both ponding areas be designed to overflow into Wyoming at or near the westerly entrance to Village Apartments as shown previously on the grading plan. Modify the area near the southwest corner by eliminating the graveled swale and replace it with a combination ponding area and drainage channel as shown in Section A-A.

3. When Wyoming is widened in the future it is recommended no median opening be left except at Dellwood Road, NE.

Another conclusion is that since the report included as Exhibit "E" indicates this work began in late 1971 there will be no further need for A.M.A.F.C.A. approval. Currently the city requires designing only for the 100 year storm which is what has been used.

It is felt that the above recommendations will be the most economical method of correcting a potentially serious problem. This report along with its recommendations should satisfy all city requirements in affect at the time this subdivision was approved.

Respectfully submitted,

Donald L. Campbell

Donald L. Campbell
P.E. & L.S. NO. 3633

THIS MICROIMAGE IS THE BEST POSSIBLE REPRODUCTION DUE TO THE POOR QUALITY OF THE ORIGINAL DOCUMENT

EXHIBIT "A"

LOCATION MAP

VILLAGE APARTMENTS

DRAINAGE ANALYSIS

C .MPBELL AND ASSOCIATES, INC. ALBUQUERQUE, NEW MEX.

RUNOFF COMPUTATIONS

Sheet No. 1

Project: VILLAGE APARTMENTS

Drainage Area No. A

Area = 8.1 acres

Maximum Overland Flow: L = _____ S = _____

Maximum Channel Flow:

Channel No. 1 L = 660 S = 1.2%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

~~Overland Flow:~~ INLET TIME 25.8 min.

Channel No. 1 Flow:

Velocity= 7.0 ft/sec; Time= $\frac{660}{7.0 \times 60}$ = 1.6 min.

Channel No. 2 Flow:

Velocity= _____ ft/sec; Time= $\frac{\quad}{\times 60}$ = _____ min.

Channel No. 3 Flow:

Velocity= _____ ft/sec; Time= $\frac{\quad}{\times 60}$ = _____ min.

Total Accumulation Time: T = 27.4 min.

$I = \frac{189}{T+25} = \frac{189}{27.4+25} = 3.61$ IN/HR

Q = CIA = (0.7)(3.61)(8.1) = 20.5 c.f.s.

Date: 11/10/73

Comp. by: DLC

Checked by: mc

TOTAL Q = 65 + 21 = 86 CFS

RUNOFF COMPUTATIONS

Sheet No. 2

Project: VILLAGE APARTMENTS

Drainage Area No. B

Area = 8.4 acres

Maximum Overland Flow: L = _____ S = _____

Maximum Channel Flow:

" Channel No. 1 L = 650' S = 1.7%

" Channel No. 2 L = 270' S = 2.2%

Channel No. 3 L = _____ S = _____

Accumulation Time

~~Overland Flow~~: INLET TIME 26.0 min.

Channel No. 1 Flow:

Velocity= 5.2 ft/sec; Time= $\frac{650}{5.2 \times 60}$ = 2.1 min.

Channel No. 2 Flow:

Velocity= 5.0 ft/sec; Time= $\frac{270}{5.0 \times 60}$ = 0.9 min.

Channel No. 3 Flow:

Velocity= _____ ft/sec; Time= $\frac{\quad}{\quad \times 60}$ = _____ min.

Total Accumulation Time: T = 29.0 min.

$I = \frac{189}{T+25} = \frac{189}{29.0+25} = 3.50$ IN/HR

Q = CIA = (.70)(3.50)(8.4) = 20.6 c.f.s.

Date: 11/10/73

Comp. by: DPC

Checked by: MC

TOTAL Q = 39 + 21 = 60 CFS

RUNOFF COMPUTATIONS

Sheet No. 3

Project: VILLAGE APARTMENTS

Drainage Area No. C

Area = 0.2 acres

Maximum Overland Flow: L = _____ S = _____

Maximum Channel Flow:

Channel No. 1 L = 400 S = 0.5%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

~~Overland Flow~~: INLET TIME 29.0 min.

Channel No. 1 Flow:

Velocity= 4.4 ft/sec; Time= $\frac{400}{4.4 \times 60}$ = 1.5 min.

Channel No. 2 Flow:

Velocity= _____ ft/sec; Time= $\frac{\quad}{\times 60}$ = _____ min.

Channel No. 3 Flow:

Velocity= _____ ft/sec; Time= $\frac{\quad}{\times 60}$ = _____ min.

Total Accumulation Time: T = 30.5 min.

$I = \frac{189}{T+25} = \frac{189}{30.5+25} = 3.41$ in/HR

Q = CIA = (0.3)(3.41)(0.2) = 0.2 c.f.s.

Date: 11/10/73

TOTAL Q = 86+60 = 146 CFS

Comp. by: DJC

Checked by: MC

EXHIBIT D

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

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

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

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

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

W	A	P	S	S1/2	R	R2/3	V	Q
.0150	14.2222	33.3426	.0050	.0707	.4265	.5666	3.9694	56.4537
.0150	14.2222	33.3426	.0100	.1000	.4265	.5666	5.6136	79.8375
.0150	14.2222	33.3426	.0150	.1225	.4265	.5666	6.8758	97.7806
.0150	14.2222	33.3426	.0200	.1414	.4265	.5666	7.9398	112.9073
.0150	14.2222	33.3426	.0250	.1581	.4265	.5666	8.8758	126.2342
.0150	14.2222	33.3426	.0300	.1732	.4265	.5666	9.7230	138.2927
.0150	14.2222	33.3426	.0350	.1871	.4265	.5666	10.5020	149.3623
.0150	14.2222	33.3426	.0400	.2000	.4265	.5666	11.2272	159.6751

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

W	A	P	S	S1/2	R	R2/3	V	Q
.0150	17.7778	33.3356	.0050	.0707	.5333	.6576	4.6067	81.8972
.0150	17.7778	33.3356	.0100	.1000	.5333	.6576	6.5149	115.8201
.0150	17.7778	33.3356	.0150	.1225	.5333	.6576	7.9791	141.8501
.0150	17.7778	33.3356	.0200	.1414	.5333	.6576	9.2134	163.7944
.0150	17.7778	33.3356	.0250	.1581	.5333	.6576	10.3009	183.1977
.0150	17.7778	33.3356	.0300	.1732	.5333	.6576	11.2941	200.8066
.0150	17.7778	33.3356	.0350	.1871	.5333	.6576	12.1989	216.8796
.0150	17.7778	33.3356	.0400	.2000	.5333	.6576	13.0298	231.6403

EXHIBIT "E"

September 15, 1971

Mr. Edward J. Denis
John L. Giusti Associates
710 East Harrison Street
Colorado Springs, Colo. 80907

Subject: Drainage Study
Re: Your letter dated August 27, 1971

Dear Mr. Denis:

1) The flow in the South Drainage Easement

2 year storm	=	25.92 CFS
25 year storm	=	52.80 CFS
100 year storm	=	64.80

The flow in the North Drainage Easement

2 year storm	=	15.64 CFS
25 year storm	=	33.15 CFS
100 year storm	=	39.12 CFS

These computations are based on U.S. Weather Bureau figures for rainfall. However, the "Albuquerque Metropolitan Arroyo Flood Control Authority" has done considerable research in rainfall and flooding in this area and suggests flow design for what they term a "standard project flood". Using their criteria, the South Drainage Easement should be designed for a flow of 140 CFS and the North Drainage Easement for a flow of 78 CFS.

2) Enclosed are the following graphs:

Depth, Duration Graph - Data from the Southern Rio Grande District Soil Conservation Service

Frequency Graphs - Data from the U.S. Department of Commerce Weather Bureau. Six hour storm and 24 hour storm.

3356

3) Enclosed are sketches of the proposed linings for the easbments. The north easement may be cobble lined to achieve the naturalistic streambed effect you intend. The design of these channels is based on A.M.A.F.C.A. standard project design flood, and/or to carry maximum flow of the channels entering the project.

4) Infiltration capacity of the native soil is being furnished you under your contract with Mr. McMillan.

It has been a pleasure serving you. Please feel free to call on us at any time.

Sincerely,

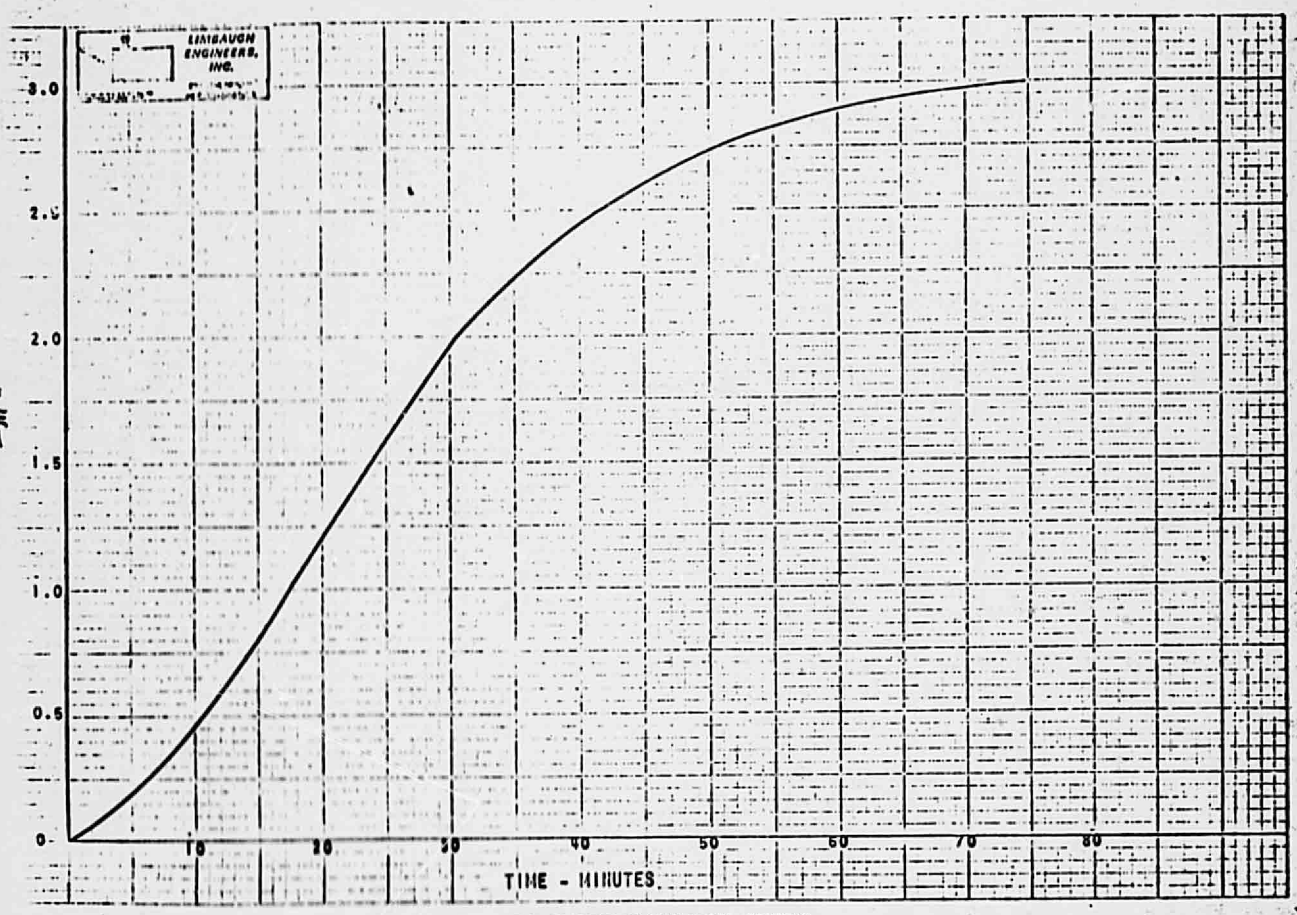
LIMBAUGH ENGINEERS, INC.

Neil D. Burger
Civil Engineer

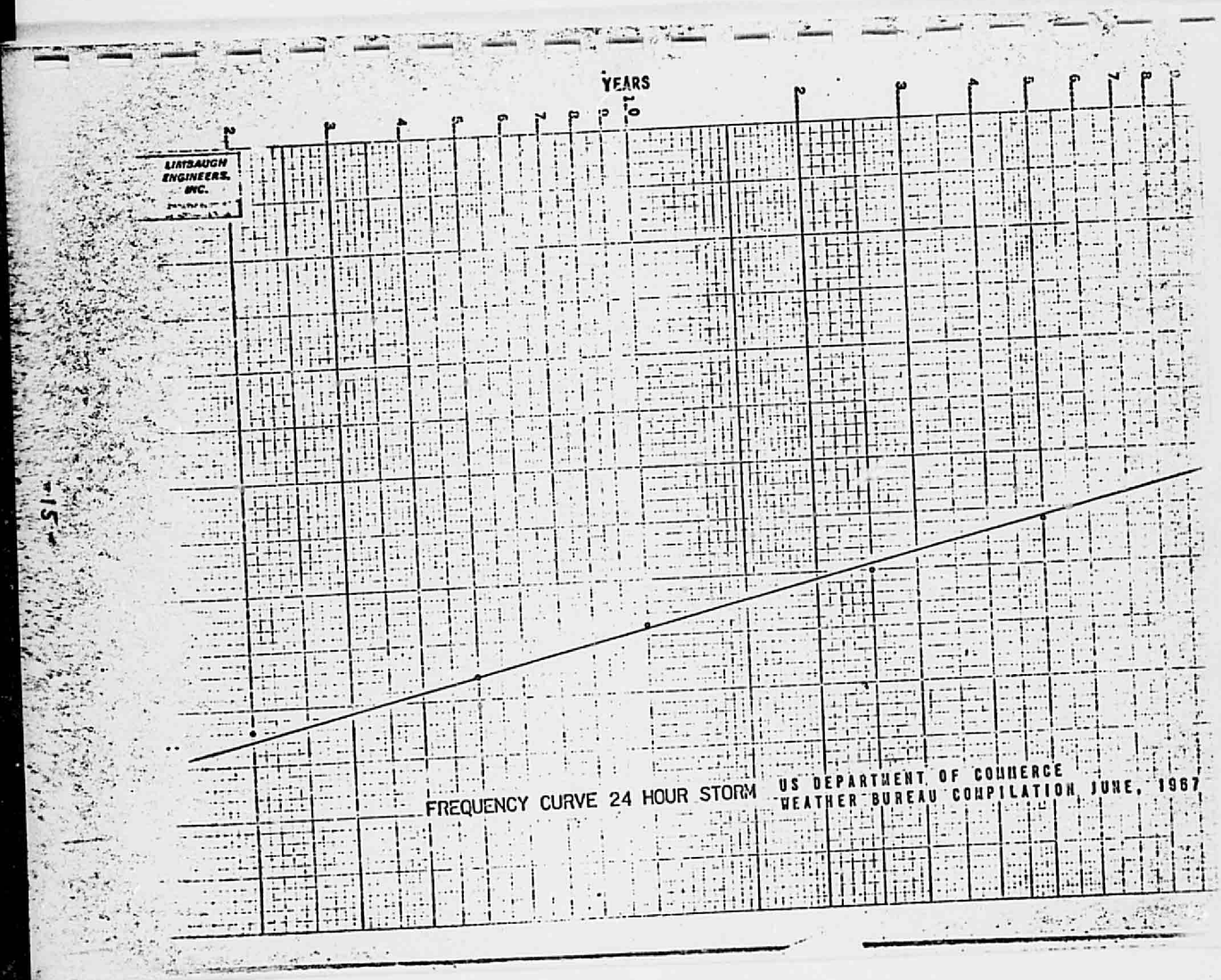
NDB/pc

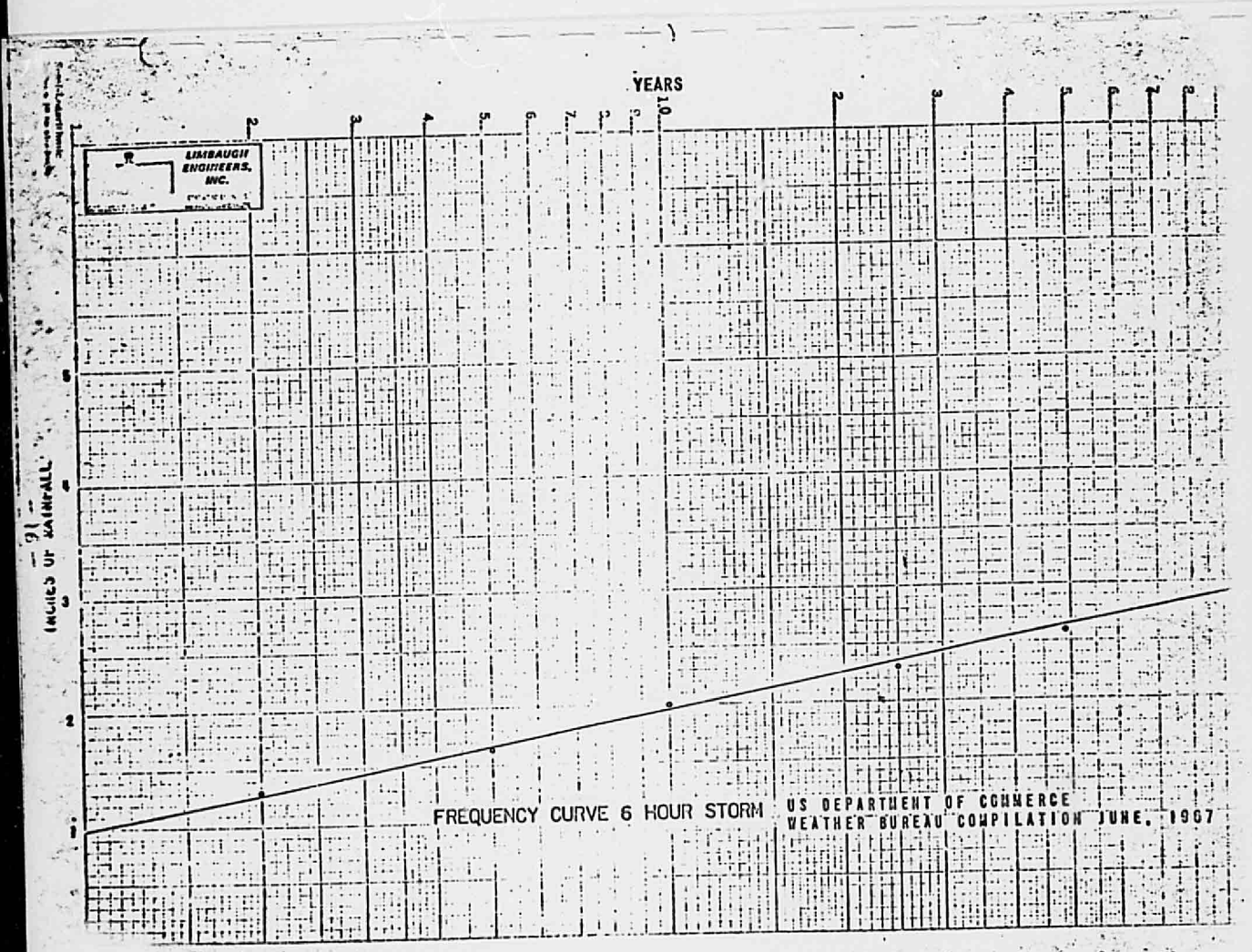
Encl.

DATA FROM SOUTHERN RIO GRANDE DISTRICT
SOIL CONSERVATION SERVICE

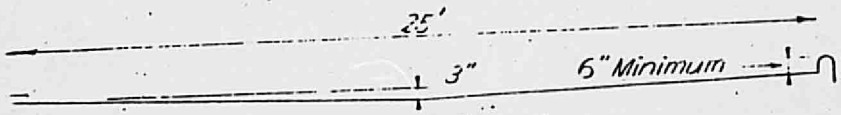


TYPICAL 3 INCH SHORT DURATION STORM

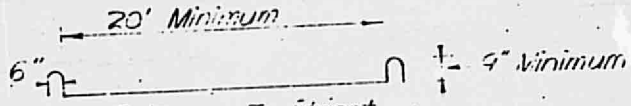

YEARS
2
3
4
5
6
7
8
9
10
LIMBAUGH ENGINEERS, INC.
FREQUENCY CURVE 24 HOUR STORM
US DEPARTMENT OF COMMERCE
WEATHER BUREAU COMPILATION JUNE, 1967


YEARS
1.0
2
3
4
5
6
7
8
9
INCHES OF RAINFALL
1
2
3
4
5
6
LIMBAUGH ENGINEERS, INC.
FREQUENCY CURVE 6 HOUR STORM
US DEPARTMENT OF COMMERCE
WEATHER BUREAU COMPILATION JUNE, 1967

FOR THE SOUTH DRAINAGE

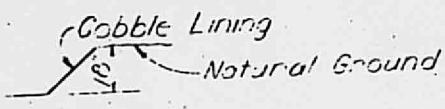


Swaled Street

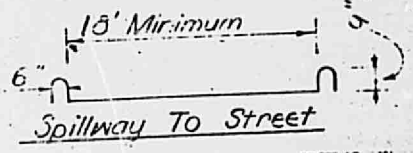


Spillway To Street

FOR THE NORTH DRAINAGE



Channel



Spillway To Street

TYPICAL CROSS SECTIONS

BIBLIOGRAPHY OF REFERENCES

1. Quality in Environment by David A. Crane and Associates, February 1970.

2. Flood Plain Information, Albuquerque Arroyos, Part I, prepared for the Albuquerque Metropolitan Arroyo Flood Control Authority by the Corps of Engineers, U.S. Army, Albuquerque District, New Mexico, June 1970 and supplement.

3. "Master Plan of Drainage-City of Albuquerque, New Mexico and Environs" by Gordon Herkenhoff and Associates, 1963.

4. Design by E.E. Seelye, Volume I, 2nd edition, 1945.

5. Miscellaneous Publication No. 204 by Dabid L. Yarnell, U.S. Department of Agriculture.

6. Handbook of Hydraulics by Horace W. King and Ernest F. Brater.

7. Urban Storm Drainage Criteria Manual, Denver Regional Council of Governments.