HYDROLOGY K21/D1 3 PLANS

K21/D1

3 Plans

LOMA VISTA OFFICE COMPLEX

DRAINAGE MANAGEMENT PLAN

JULY 1979

RECEIVED
JUL 30 1979
CITY ENGINEER

PREPARED FOR:

LAWRENCE GARCIA

PREPARED BY:

COMMUNITY SCIENCES CORPORATION

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NEW MEXICO
REGISTERED PROFESSIONAL ENGINEER

SURVEYING
ENGINEERING
LAND PLANNING

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TABLE OF CONTENTS

	PAGE
A) PURPOSE AND SCOPE	One
B) SITE LOCATION AND TOPOGRAPHY	One
C) DESIGN CRITERIA	
1) Engineering Parameters	One
2) Flood Control Regulations	One
D) COMPUTATIONAL PROCEDURES	Two
E) OFF-SITE DRAINAGE	Two
F) ON-SITE DRAINAGE	Two, Three & Four
APPENDIX "A" - Calculations	Five thru Ten
PLATE 1 - Location and Off-Site Drainage Map	Ten
PLATE 2 - Drainage Plan	Packet One

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A) PURPOSE AND SCOPE

Lawrence Garcia Architects is currently planning development of a 4-acre parcel in Northeast Albuquerque. This area shall contain three office structures, a Racquetball Clubhouse, parking lot stalls and be encircled with a variety of trees in landscape easements. The purpose of this report is to present a drainage management plan for this development acceptable to the City of Albuquerque and to the Albuquerque Metropolitan Arroyo Flood Control Authority.

B) SITE LOCATION AND TOPOGRAPHY

The proposed development is located at the Southeast corner of Hotel Drive (a privately owned and maintained street) and Lomas Boulevard in Northeast Albuquerque (see Plate 1). The project will hereinafter be referred to as the Loma Vista Office Complex.

The subject parcel slopes from East to West at an average rate of 3%. Soils consist largely of alluvial sands and silts, and decomposed granite is the major soil constituent.

C) DESIGN CRITERIA

1) Engineering Parameters:

For calculation of runoff rates and required storage volumes, a C of 0.83 has been calculated for developed areas, and a C of 0.4 was used for undeveloped areas.

All runoff calculations have been based on a 100 year, 6 hour rainfall of 2.8" (0.23') per AMAFCA requirements.

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

2) Flood Control Regulations:

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

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D) COMPUTATIONAL PROCEDURES

Appendix "A" contains samples of the various types of hydraulic calculations performed. Proposed swales were sized based on the Manning Equation for Uniform Flow. Street carrying capacities were calculated by means of the same equation.

Hydrological flow rate calculations are based on the rational runoff method. Times of concentration were all assumed to be 10 minutes or less. Volume calculations for satisfying overall ponding requirements were performed by multiplication of the calculated composite C factor minus the natural C factor times the 100 year - 6 hour rainfall (0.23') times the area to obtain cubic feet of water.

E) OFF-SITE DRAINAGE

The commercial parcel to the East of the site contributes off-site runoff to the development. Data for runoff computations was secured from 1" = 200' AMAFCA topographic maps although Plate 1 indicates the vicinity of this area in general terms.

Off-site runoff is primarily in the form of sheet flow with a tendency to discharge to the Southwest corner of the site.

With an intent to avoid the possibility of this runoff reaching the building areas and/or introducing large amounts of sedimentation to the parking lots thereby plugging the entrances to the infiltration galleries, a macadem curb and graded earth swale section will be provided to direct these flows into the nine foot wide landscaped strip along the Southern boundary of the property. This strip will be graded into a swale section, however, since it will be landscaped it will facilitate infiltration.

F) ON-SITE DRAINAGE

In accordance with AMAFCA requirements, various types of site ponding will be utilized and are discussed individually as follows:

I. PHASE I - Racquetball Club and Parking Lots:

(1) Landscaped Strip Ponds: Two landscaped ponding strips will be provided in and around the Racquetball Clubhouse. Parking Lot runoff will be directed into these strip basins by means of general parking lot grading. None of the ponds will have outlets, but ponds 1 and 2 will spill over into the Phase I infiltration gallery in the event either pond fills to capacity. Both ponds will have some landscaping afforded to them and provide a buffer against a nuisance flow runoff from smaller and more frequent storms.

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(2) Infiltration Gallery: One subsurface infiltration gallery will be provided in the Southwest corner of the Phase I area. This area, 42 x 42 feet by 4 feet deep, will be filled by 1-2 inch diameter cleaned crushed stone and is designed to handle a total of 1610 cubic feet of runoff. Runoff from Clubhouse roof drains as well as the upper parking lot will be directed into the gallery by way of the parking lot grading.

(3) Roof Ponds: The Racquetball Clubhouse roof will be flat utilizing interior drain systems. An explanation of the operation and equipment involved in draining those roof ponds will be given in the Phase II Drainage Analysis.

II. PHASE II - Office Buildings and Parking Lot:

(1) Major Ponding Basins: A total of five ponding basins will be provided to receive runoff from the three office building roofs and half of the West and East parking lot surfaces of the Phase II site. A drainage swale will convey the controlled roof runoff from one half of the two North office buildings, plus the landscaped areas immediately adjacent, to Pond #6. This pond will also contain runoff from approximately one half of the West parking lot and will overflow to Hotel Street through a sidewalk swale. Ponds #3, #4, and #5 will receive the controlled runoff from the remaining building roofs and their contained landscaped areas as well as the drainage from one half of the East parking lot. These ponds will overflow to the Southwest parking lot through sidewalk swales. The location of these ponds was determined to follow the natural drainage of the area in the Southwesterly direction.

(2) Infiltration Gallery: A subsurface infiltration gallery will be provided in the West parking lot just North of the Southwestern entrance to the site. This chamber will be designed to contain, and allow the infiltration of, 3027 cubic feet of runoff from the South parking lot and one half of the West and East parking lots during peak periods. Water blocks at the entrances to the site will preclude runoff exiting to the street while permitting the developed flow to be fully contained at the infiltration gallery location. A sidewalk drainage swale will permit overflow from the gallery to enter Hotel Street N.E.

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(3) Roof Ponds: All roof areas will be flat utilizing interior drain systems. Zurn Control-Flo Roof Drains will be utilized to control the rate of discharge of roof runoff. Roof drains will be selected with the pre-set discharge rate to dissipate the 100 year rainfall of 0.23 feet in 8-12 hours. With proper roof spacing, this will eliminate the peak runoff effect of the roof areas. All roof areas drain to other surface ponds and hence allows runoff an opportunity to infiltrate prior to leaving the site. Each roof shall contain at least two Zurn Control Flo roof drains located as shown on Plate 2 with one notch per drain. With each drain discharging a maximum of 0.06 cfs during the 100 year storm, a maximum of 0.5 cfs will discharge from the roof areas at or below a water depth of 0.23 feet. Two drains per roof will provide a factor of safety in the event of one drain being obstructed for any reason.

Above 0.23 feet, the control flow drains will be set to discharge freely to prevent roof overloading. It is recommended that 1.5 LF of overflow scupper be provided in the roof parapets for every 1000 SF of roof area. These shall be located 3" above the roof surface. A discharge pipe 2" in diameter for each drain will permit up to 30 gpm of water each to be evacuated.

The combined storage and infiltration effects of these ponds will meet the AMAFCA requirements as shown in Appendix "A".

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APPENDIX "A"

Summary - Runoff Surfaces

Phase #1

Total Area = 1.18 acres

Racquetball Clubhouse = 0.33 acres

Planters and Gardens = 0.12 acres

Parking Paving = 0.73 acres

Phase #2

Total Area = 2.96 acres

Office Buildings = 0.61 acres

Sidewalks and Parking = 1.78 acres

Planters and Gardens = 0.57 acres

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PHASE #1 - Sample Calculations

1) Composite C:

Gross Area = 51,400 SF

Roof and Paved Areas @ C = 0.95 = 46,174 SF = 89.8%

Landscaping @ C = 0.70 = 5,227 SF = 10.2%

Ccomp = (0.898 x 0.95) + (0.102 x 0.70) = 0.92

2) Required Ponding Volume:

R (100 yr-6 hr) = 2.8" = 0.23'

Cnatural = 0.4

Volume = (0.92-0.4) (0.23) (51,400)
= 6147 cf

3) Available Ponding:

a) roof tops

available area = 14,400 SF

available volume = 0.95 x 0.23 x 14,400
= 3146 cfs

b) pond #1

66 x 1 + 78 x 13 = 1000 cf

c) pond #2

$$\frac{90 \times 10 + 87 \times 7}{2} \times .5 = 377 \text{ cf}$$

area drained = 3780 SF

Ccomp = 0.88 ∴ Volume = 0.48 x 0.23 x 3780 = 423 cf > required

d) infiltration gallery

Vol required - Volume (ponds & roof) = Volume (Gallery)

6147 - 4603 = 1544 cf

$$\therefore \text{gallery dimensions} = \frac{42' + 26'}{2} \times 4 \times .33 = 1610$$

1610 > 1544 cf

TOTAL AVAILABLE VOLUME 6213 > 6147 cf

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PHASE #II - Sample Calculations

1) Composite C:

Gross Area = 128,938 SF

Roof and Paved Areas @ C = 0.95 = 97,666 = 75.7%

Landscaped Area @ C = 0.70 = 31,272 = 24.3%

Ccomp = (0.95 x 0.757) + (0.243 x 0.70) = 0.89

2) Required Ponding Volume:

R (100 yr-6 hr) = 2.8" = 0.23

Cnatural = 0.4

Volume = (0.89 - 0.4) (0.23) (128,938)
= 14,531 cf

3) Available Ponding:

a) roof tops

available area = 26,373

available volume = 0.95 x 0.23 x 26,373
= 5763 cf

b) ponds #3, #4, and #5

pond #3 = 1575 cf
pond #4 = 1120 cf
pond #5 = 719 cf
3415 cf

c) pond #6 = $\frac{56 \times 27 + 44 \times 15}{2} \times 2.25 = 2443$ cf

d) infiltration gallery #2

remaining volume required

14,531 cf - 11,621 = 2910 cf

gallery = $\frac{55' \times 39'}{2} \times 4 \times .333 = 3027$ cf > 2910 cf

TOTAL AVAILABLE VOLUME = 14,648 > 14,531 cf

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4) Off-Site Flow Rate:

Area = 2.2 acres

C = 0.74

I_{100} = 5.4 inches/hour

Q = 0.74 x 5.4 x 2.2 = 8.8 cfs

5) Capacity of Macadem Curb Diversion:

BW = 5'

SS = 0

S = 0.005

d = 0.67'

n = 0.025

$Q = A \frac{1.49}{n} R^{2/3} S^{1/2}$

= 9.2 cfs > 8.8

vel = 2.75 fps - non erosive

6) Flow Rate - West End of Driveway:

On-Site Area = 0.63 acres

C = 0.95

I_{100} = 5.4 inches/hour

Q = 0.95 x 5.4 x 0.63 = 3.2 cfs

7) Capacity of Asphalt Drive Inverted Crown:

BW = 0'

SS = 24

S = 2% min

d = 0.5'

n = 0.015

$Q = A \frac{1.49}{n} R^{2/3} S^{1/2}$

= 33 cfs > 3.2

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8) Capacity South Boundary Swale:

BW = 9'

SS = 3:1

S = 0.0333

n = 0.04

$Q = A \frac{1.49}{n} R^{2/3} S^{1/2}$

$Q = 5.0 \times 37.25 \times (0.54)^{2/3} \times (0.0333)^{1/2}$ $R = \frac{(9+1)\ 1 \times .5}{9.24}$

$Q = (5.0)\ (37.25(0.662)\ (0.182)$ R = 0.54 ft

$Q = 22.44$ cfs > 8.8 cfs A = 5.0 SF

9) Capacity of North Boundary Swale:

BW = 5'

SS = 4:1

S = 0.0260

n = 0.04

$Q = A \frac{1.49}{n} R^{2/3} S^{1/2}$ $R = \frac{6 \times .25}{5.12}$

$Q = (1.5)\ (37.25)\ (0.44)\ (0.161)$ R = 0.293

A = 1.5

Q = 3.96

Zurn control = 0.05 cfs x 2 = 0.1 cfs

Landscaped and S/W area 9758 SF = 0.22 ac

C = 0.70 I = 5.4

Q = CIA ∴ 0.7 x 5.4 x 0.22 = 0.83 cfs

+ 0.10 cfs

0.93 cfs

3.96 > 0.93 cfs

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INFILTRATION GALLERY - INLET CALCULATIONS

Phase I & II

Clubhouse Roof: Assume 34 GPM discharge at peak periods

34 GPM = 0.1 cfs over parking lot

Parking Lot: Velocity = 2.1 fps. From Soil Conservation Service Tech Release #55, January, 1975.

$$\text{time } C = \frac{L}{V(60)} = \frac{410}{2.1 \times 60} = 3.25 \text{ min} < 10 \text{ min}$$

$Q = CIA$

$A = 0.73$ acres

$C = 0.95$

$Q = 0.95 \times 5.4 \times 0.73$

$Q = 3.74$ cfs (say 4 cfs)

$$I = \frac{189}{tc+25}$$

$I = 5.4$

$H = 1.0$

$Cd = 0.65$

$$Q = Ca \times Ao \times \sqrt{2\,gH}$$

$$Ao = \frac{4}{0.65 \times 8.02} = 1 \times \text{safety factor (2)}$$

$$= 2 \text{ SF}$$

Inlet shall be 2'x1' square by one foot deep in both locations or a Standard City of Albuquerque Type D inlet.

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PLATE 1

LOCATION & OFFSITE DRAINAGE MAP

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LEVERTON - DENNEY ENGINEERS, Inc.

5643 PARADISE BLVD., N.W.
ALBUQUERQUE, NEW MEXICO 87114
(505) 898-2457

June 19, 1974

DRAINAGE REPORT

FOR

CABOT, CABOT & FORBES OFFICE BUILDING

11300 Lomas Boulevard N.E.

1. PURPOSE: The purpose of this report is to present the results of analyses performed to develop a drainage management plan for an office building to be constructed at the southeast corner of Lomas Blvd. and Tomasita Street N.E., in the City of Albuquerque.

2. GENERAL: The building proposed for immediate construction contains 15,360 square feet together with parking spaces for 80 cars. It is anticipated that the building will be doubled in size and parking for 140 cars provided.

The preliminary objective is to contain all runoff anticipated from the 100 year rain on the site, both for the Phase I improvements and the future Phase II.

The building will be drained by six downspouts with one-half the building draining to the East and half to the West.

3. PHASE I: 6 hr. 100 yr. rainfall = 2.7" = 0.225 ft.

Bldg. Area = 15,360 ft^2

1/2 to east planter = 7680 ft^2

3/8 to west planter = 5760 ft^2

1/8 to parking lot = 1920 ft^2

Paving Area, Total = 42,180 ft^2.

To East Pond #1 = 11,250 ft^2.

Ponding Area # 1:

Bldg. 7,680 ft^2

Paving 11,250 ft^2

Total 18,930 ft^2 = 100% Runoff.

Pond Area = 5058 ft^2

Runoff Volume = 18,930 X 0.225 = 4259 ft^3

Depth Required = 4259/5058 = 0.84'

Pond to elevation 96 depth = 1.5'. OK.

Ponding Area # 2:

OK by Inspection.

Only sidewalk drains to it.

Set 6" below walk.

Ponding Area # 3:

Must hold runoff from 1/8 building or 1920 ft^2

Volume = 1920 X 0.225 = 432 ft^3

Area of Pond = 450 ft^2

Depth Required = 432/450 = 0.96'. OK.

Ponding Area # 4:

Area = 1/4 Bldg. = 3840 ft^2

Volume = 3840 X 0.225 = 864 ft^3

Area of Pond = 1140 ft^2

Depth Required = 864/1140 = 0.76'. OK.

Ponding Area # 5:

Paving Area drained = 30,930 ft^2

Building Area drained = 1920 ft^2

Vacant Area drained = 60,800 ft^2 - 50% Runoff.

Runoff = (30,930 + 30,400 + 1920) X 0.225 = 14,231 ft^3

Area of Pond = 8100 ft^2

Depth Required = 14,231/8100 = 1.76'.

Depth Provided = 2'.

4. PHASE II:

A. Ponding Area # 1 will be expanded by 5200 ft^2.

B. Additional 7680 ft^2 of Building will drain to Pond # 1.

C. 15,360 ft^2 of paving from Phase I will be eliminated.

D. 3,200 ft^2 of paving will be added to drain to Pond # 1.

Revised Pond Area # 1:

Pond Area = 5058 = 5200 = 10,258 ft^2

Drainage Areas:

Bldg. =	15,360 ft^2
Paving =	3,200 ft^2
Total	18,560 ft^2 - 100% Runoff.

Volume = 18,560 X 0.225 = 4176 ft^3

Depth Required = 4176/10,258 = 0.41'. OK.

Revised Pond Area # 5:

A. Add 7,680 ft^2 of Building.

B. Add 40,825 ft^2 of Paving.

C. Delete 40,825 ft^2 of Vacant Area.

D. Delete 4,110 ft^2 of Paving.

RECAP:

Bldg. 9,600 ft^2

Paving 67,645 ft^2

Sub Total 77,245 ft^2 - 100% Runoff

Vacant = 19,975 ft^2 - 50% Runoff

Volume = (77,245 + 9987) X 0.225 = 19,627 ft^3

Area of Pond = 8100 ft^2

Depth Required = 19,627/8100 = 2.43'.

Note: Increase Pond Area in Phase II to 10,000 ft^2.

Depth Required = 19,627/10,000 = 1.96'. OK.

5. CONCLUSIONS & RECOMMENDATIONS: Based on the analyses which have been performed and the grading plan which has been completed, 100% of the runoff for a 100 year rain can be retained on the site.

It will be noted that infiltration or percolation in the ponding areas has been neglected. Percolation rates on the order of 3 to 4 inches per hour are anticipated. These losses will add somewhat to the degree of protection afforded. Since maximum ponding depth in any pond is 24" it can be anticipated that all ponded runoff will infiltrate in 8 to 10 hours.

A complete landscape plan is being developed which will provide for grass or other ground cover in Ponding Areas #1 to #4, inclusive, thereby insuring infiltration.

Ponding Area #5 is a temporary holding area which will not be landscaped. This area will be eliminated as development to the West occurs and other permanent landscaped drainage management areas are provided.

We recommend that the site be developed as shown on the drainage and grading plans submitted herewith.

FND/am

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The preliminary objective is to contain all runoff anticipated from the 100 year rain on the site, both for the Phase I improvements and the future Phase II.

The building will be drained by six downspouts with one-half the building draining to the East and half to the West.

3. PHASE I: 6 hr. 100 yr. rainfall = 2.7" = 0.225 ft.

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HOTEL & LOMAS OFFICE COMPLEX

DRAINAGE MANAGEMENT PLAN

Prepared For

Lawrence Garcia

By

Community Sciences Corporation

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STATE OF NEW MEXICO
NO. 6170
REGISTERED PROFESSIONAL ENGINEER

June 1978

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SURVEYING
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TABLE OF CONTENTS

		Page
A)	PURPOSE AND SCOPE	1
B)	SITE LOCATION AND TOPOGRAPHY	1
C)	DESIGN CRITERIA	1
	1) Engineering Parameters	
	2) Flood Control Regulations	
D)	COMPUTATIONAL PROCEDURES	2
E)	OFF-SITE DRAINAGE	2
F)	ON-SITE DRAINAGE	2 & 3
	PLATE 1 - Location & Off-Site Drainage Map	
	PLATE 2 - Drainage Plan	
	APPENDIX A - Calculations	4 & 5

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D) COMPUTATIONAL PROCEDURES

Appendix A contains samples of the various types of hydraulic calculations performed. Proposed swales were sized based on the Manning Equation for Uniform Flow. Street carrying capacities were calculated by means of the same equation.

Hydrological flow rate calculations are based on the rational runoff method. Times of concentration were all assumed to be 10 minutes or less. Volume calculations for satisfying overall ponding requirements were performed by multiplication of the calculated composite C factor minus the natural C factor times the 100 year-6 hour rainfall (0.23') times the area to obtain cubic feet of water.

E) OFF-SITE DRAINAGE

Runoff approaches the site from a commercial parcel to the east. Plate I shows the off-site drainage area, however this area was measured from 1"=200' AMAFCA topographic maps for accuracy sake.

Off-site runoff is primarily in the form of sheet flow, however it has a tendency to discharge to the southwest corner of the site. In order to avoid the possibility of this runoff reaching the building area, a macadem curb and graded earth swale section will be provided to direct these flows into the driveway swale and through the site.

F) ON-SITE DRAINAGE

In order to meet the AMAFCA requirements several forms of on-site ponding will be employed. These will be discussed individually as follows:

(1) Central Ponding Basins

Two large ponding basins will be provided in and around the building area. Runoff from roof drains as well as the upper parking lot will be directed into these ponding basins by means of swales and general site grading. None of the ponds will have outlets as such. Pond #1 will spill over into #2 which in turn will spill over into Lomas Boulevard in the event either pond fills to capacity. Pond #1 will have some decorative landscaping and possibly some permanent water in it below the basic storage, floor elevation specified.

(2) Strip Ponds

Three strip ponds will be provided in parking lot areas parallel to natural contours. The function of these will be to provide a small amount of storage and also to provide infiltration areas for parking lot run-off. These strip ponds will provide a buffer against nuisance flow runoff reaching the streets following smaller, more frequent storms.

(3) Roof Ponds

All roof areas will be flat utilizing interior drain systems. Zurn Control-Flo Roof Drains will be used to control the rate of discharge of roof runoff. Roof drains will be selected such that the number used coupled with the pre-set discharge rate will dissipate the one hundred year rainfall of 0.23' in 24 hours. This will eliminate the peak runoff effect of the roof areas, and since all roof areas drain into other surface ponds, it will allow runoff an opportunity to infiltrate prior to leaving the site. The total discharge rate for all roof drains combined shall not exceed 34 gpm peak at or below a water depth of 0.23'. Above 0.23' the control flow drains will be set to discharge freely to avoid roof over-loading. It is recommended that 1 1/2 LF of over-flow weir be provided in the roof parapets for every 1000 SF of roof area. The weir elevations should be set at 0.23' above roof elevation in the parapets.

The combined storage and infiltration effects of these ponds will meet the AMAFCA requirements as shown in Appendix A.

APPENDIX A

SAMPLE CALCULATIONS

1) Composite C:

Gross Area =		175,840 SF	
Roof & Paved Areas @ C =	0.95 =	135,152 SF	= 77%
SW Landscaping @ C =	0.70 =	13,560 SF	= 8%
Grassed Area @ C =	0.25 =	27,128 SF	= 15%

C_{Comp} = (0.77 X 0.95) + (0.08 X 0.70) + (0.15 X 0.25)
= 0.83

2) Required Ponding Volume:

R (100 yr-6 hr) = 2.8" = 0.23'
$C_{Natural}$ = 0.4
Volume = (0.83 - 0.4) (0.23) (175,840)
= 17,643 c.f.

3) Available Ponding:

a) roof tops
Available area = 30,572 SF
Available volume = 0.95 X 0.23 X 30,572
= 6,680 c.f.

b) strip ponds
Volume = $\frac{(5+1)(165 + 145 + 260)}{2}$ = 1,710 c.f.

c) pond #1
Volume = $\frac{(31 \text{ X } 48) + (36 \text{ X } 19)\ (2)}{2}$ = 2,172 c.f.

d) pond #2
Volume = $\frac{(80 \text{ X } 43) + (28 \text{ X } 65)\ (3)}{2}$ = 7,890 c.f.

Total Available Volume = 18,452 > 17,643

4) Offsite Flow Rate:

Area = 2.2 acres
C = 0.74
I_{100} = 5.4 in/hr

Q = 0.74 X 5.4 X 2.2 = 8.8 c.f.s.

5) <u>Capacity of Macadem Curb Diversion (Section C)</u>:

BW = 5'
SS = 0
S = 0.005
d = 0.67'
n = 0.025

$$Q = A \frac{1.49}{n} R^{2/3} S^{1/2}$$

= 9.2 c.f.s. > 8.8
Vel = 2.75 f.p.s. - non erosive

6) <u>Capacity of Asphalt Drive Inverted Crown (Section B)</u>:

BW = 0'
SS = 24
S = 2% min.
d = 0.5'
n = 0.015

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

= 33 c.f.s. ≫ 12

7) <u>Flow Rate - West End of Driveway</u>:

Offsite Q = 8.8 c.f.s.
Onsite Area = 0.59 acres
C = 0.95
I_{100} = 5.4 in/hr

Q = (0.95 X 5.4 X 0.59) + 8.8 = 12 c.f.s.

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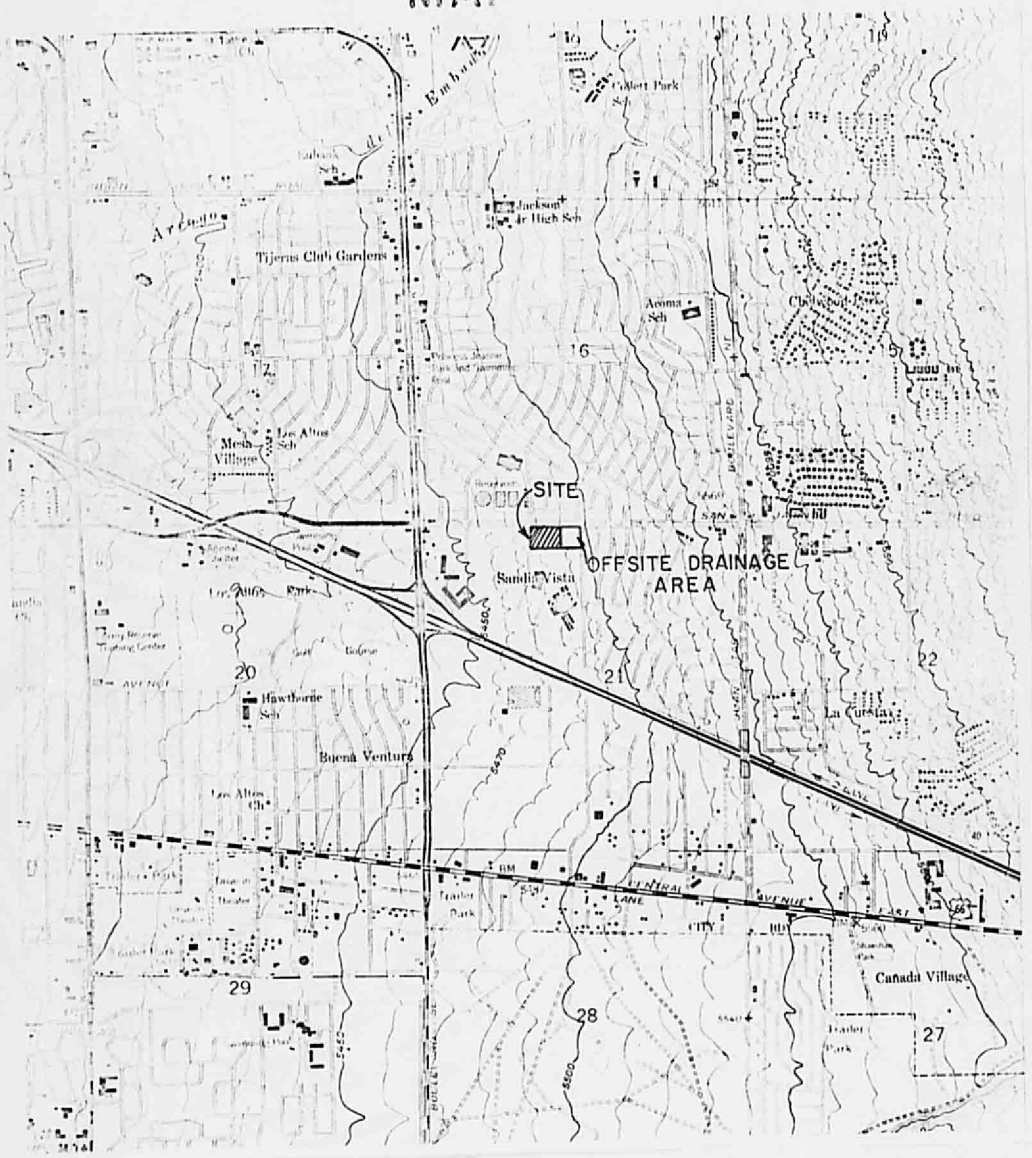
PLATE 2

LOCATION & OFFSITE DRAINAGE MAP