

FINAL  
DRAINAGE REPORT  
for  
MONTANA DEL SOL

**American Engineering Company**

**Consulting Engineers**



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2011-11-16  
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**FINAL  
DRAINAGE REPORT**  
for

**MONTANA DEL SOL**

PREPARED BY:  
DAN TOBAR, E.I.T., FRANK M. GU, E.I.T. & SCOTT M. LARSON, P.E.



**AMERICAN ENGINEERING COMPANY**  
21442 North 20th Avenue  
Phoenix, Arizona 85027  
(602) 582-0260

January 7, 1995  
AEC Job No. 93248

**Final Drainage Report  
for  
Montana Del Sol**

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## **1.0 INTRODUCTION**

Montana Del Sol is located in the North 1/2 of the Northwest 1/4 of the Southwest 1/4 of Section 11, Township 4 North, Range 1 East, Gila Salt River Base and Meridian. Foothills lie to the Northwest, about a half mile away. The site itself is relatively flat with about ten (10) feet of fall from the Northwest corner to the Southeast corner. There is desert vegetation on part of the site. The other part has been bladed to remove the desert vegetation, so grasses, flowers and weeds are in that bladed area.

Montana del sol has approximately 20 acres of gross area with a total of 32 lots. The site is located in Maricopa County's R1-18 Zoning. The average lot size is 18,010 square feet.

## **2.0 OFF-SITE DRAINAGE**

Most of the off-site storm runoff comes off the foothills Northwest of the project site. Area 1 (Refer to the attached Offsite Drainage Map) has approximately 118 acres and contributes 380 cfs of runoff from a 100-year storm. The water will be intercepted by a drainage swale along the North side of Calle Lejos. The swale is directed East along Calle Lejos alignment to the Northwest corner of Montana del sol. Based on cross-sections taken in the field and Manning's equation, the swale will carry about 137 cfs. Runoff in excess of this capacity flows across the street to the South. Runoff from Area 2 was found to be 184 cfs. It will flow along 83rd Avenue south to the intersection of 83rd Avenue and Calle Lejos. Then the water will combine with said

137 cfs at this intersection. We propose an earth channel along the South side of Calle Lejos and adjacent to the site to take approximately 200 cfs East to 81st Avenue ( See Appendix A). CMX Group Inc. has designed three 24" RGRCP and two 2'x12" Concrete Box Culverts to take approximately 200 cfs of water under the intersection into this channel. The water will then be carried by another channel East and then South to the existing wash as shown in the Offsite Drainage Map. Any flow in excess of 200 cfs at the intersection of Calle Lejos and 83rd Avenue will overtop the crown of the roadway and flow south along 83rd Avenue.

Calle Lejos Estates, a single family site directly north of Montana del sol and Calle Lejos will intercept all the flow from Area 3 and direct it East to the wash. Calle Lejos Estates will also retain all its storm runoff from a 100-year runoff.

All offsite drainage calculations are shown in Appendix A and the Offsite Drainage Map is attached in Appendix D.

### **3.0 ONSITE DRAINAGE**

The onsite storm runoff will be carried by curb and gutter to two retention basins located East and Southeast of the project site. The runoff coefficient was calculated and determined to be 0.52.

Streets are designed to contain 10-year runoff below the curb. Vertical curbs are installed where is necessary. See onsite drainage map in Appendix D for vertical curb section and street calculations. For a 100-year storm runoff, the water will rise above the top of the curb for no more than 0.15'.

#### **4.0 RETENTION PLAN**

The project site is required to retain 100-year 2-hour storm runoff. A "C" value of 0.52 was used to determine the required volume. Two basins as shown in Onsite Drainage Map are set to have the same high water elevation of 1322.20' and a total volume of 96,318 ft<sup>3</sup>. The volume calculations are shown in Appendix C. A 15" RGRCP will be installed to connect the two basins. The outfall of the basin is at the Southeast corner of the project site. Two drywells are planned as shown in the Onsite Drainage Map to drain the basins within 36 hours. One drywell may be permitted if verified by percolation test.

All finished floors will be set at least 12" above the high water elevation.

## **APPENDIX A**

Offsite Drainage Calculations.

Flood Control District of Maricopa County  
Hydrologic Design Manual Rational Method

Computed by: FRANK GU

Date: 01-07-95

LOCATION DATA

Location: T4N R1E S10

Project Name: AEC 93248

Subarea id: AREA 1

Drainage Area Cover: DESERT

DESIGN DATA

Drainage Area 118.00 acres

Watercourse Length 4700.0 feet

Top Elevation 1830.0 feet

Bottom Elevation 1330.0 feet

Slope .10638 feet/feet

Roughness Coefficient (Kb) .05153

10-Year, 6-Hour Rainfall 2.10 inches

Hydrological Summary Table  
-----

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	108	150	171	253	316	380
C	0.350	0.350	0.350	0.385	0.420	0.438
Tc (min)	13.5	11.9	11.3	10.1	9.6	9.1
i (in/hr)	2.6	3.6	4.1	5.6	6.4	7.4

Flood Control District of Maricopa County  
Hydrologic Design Manual Rational Method

Computed by: FRANK GU

Date: 01-07-95

LOCATION DATA

Location: T4N R1E S10

Project Name: AEC 93248

Subarea id: AREA 2

Drainage Area Cover: DESERT

DESIGN DATA

Drainage Area 54.00 acres

Watercourse Length 3500.0 feet

Top Elevation 1730.0 feet

Bottom Elevation 1330.0 feet

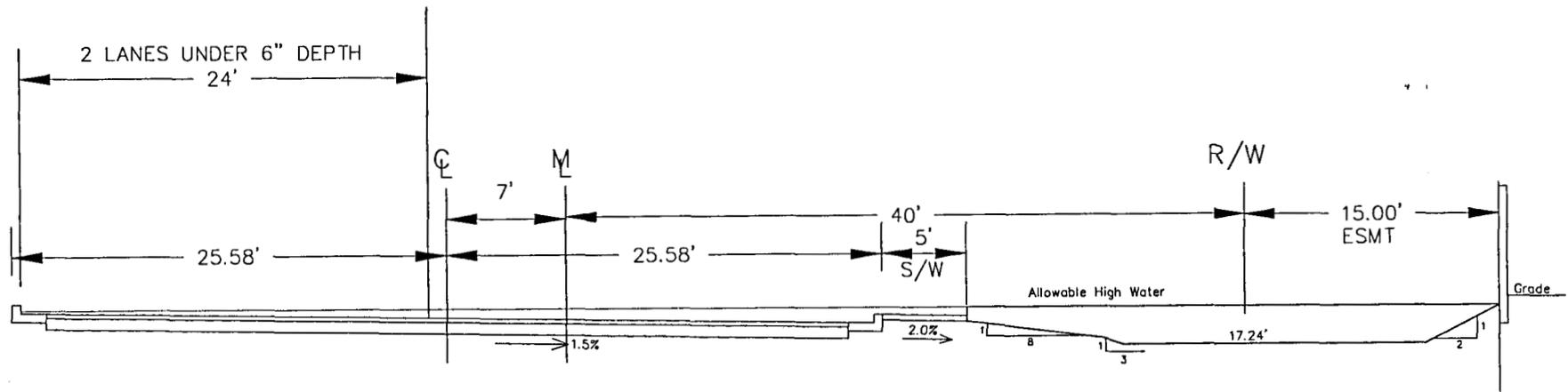
Slope .11429 feet/feet

Roughness Coefficient (Kb) .05620

10-Year, 6-Hour Rainfall 2.10 inches

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	53	73	83	123	153	184
C	0.350	0.350	0.350	0.385	0.420	0.438
Tc (min)	11.6	10.2	9.7	8.7	8.3	7.8
i (in/hr)	2.8	3.9	4.4	5.9	6.8	7.8



### Calle Lejos Drainage Section

Area = 57.48 sf

Slope = 0.0025 ft/ft

Wetted Perim. = 32.90

n avg. = 0.025

Hydraulic Radius = 1.747

Q capacity = 248 cfs

SEC B-B

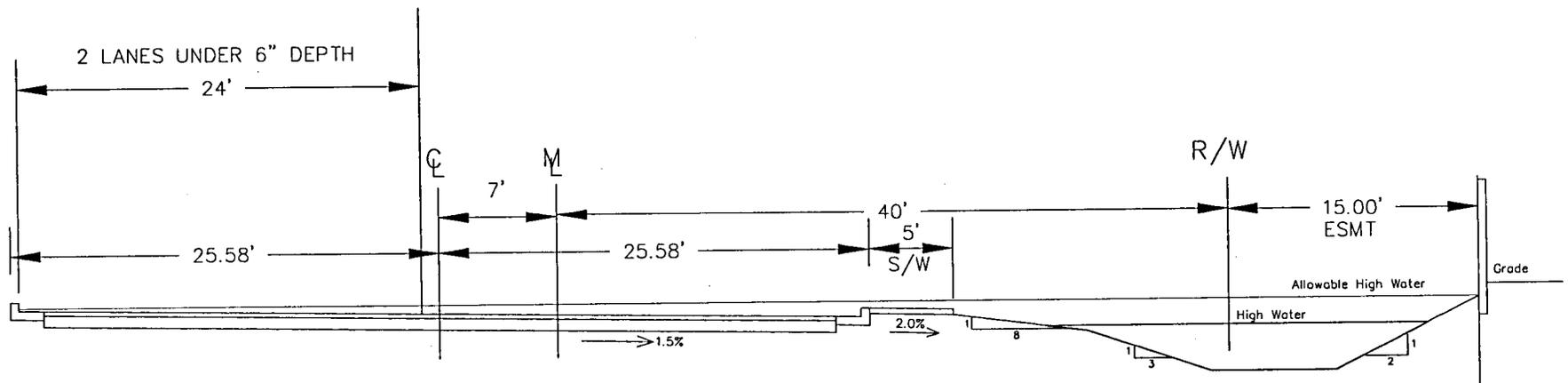
STA

FL=

TC=

Yn= 2.22 FT

Capacity of channel area only.  
Water surface at allowable high water.  
Street capacity not considered.



### Calle Lejos Drainage Section

Area = 39.78 sf

Wetted Perim. = 23.82

Hydraulic Radius = 1.670

Slope = 0.004 ft/ft

n avg. = 0.025

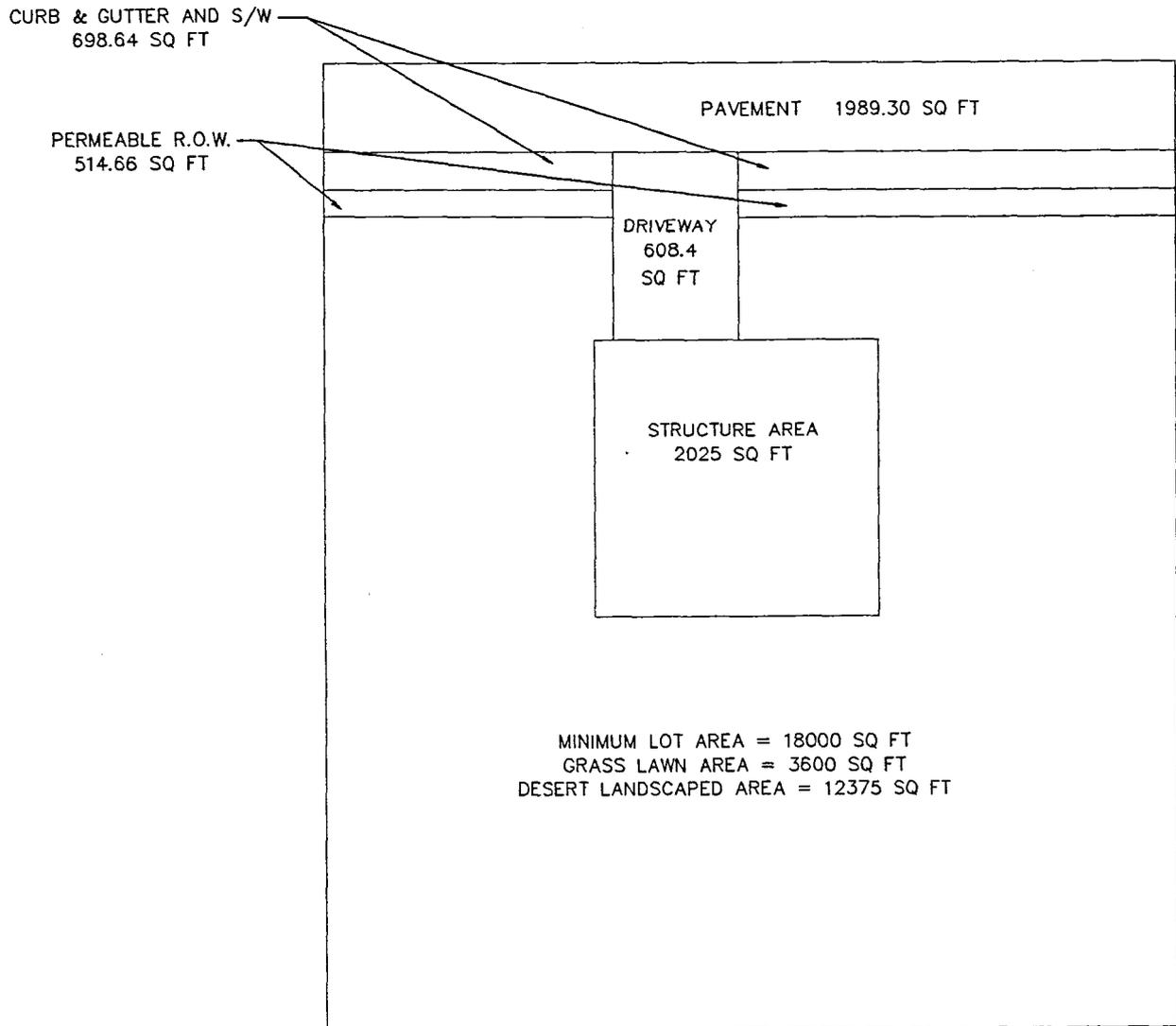
Q capacity = 211 cfs

SEC A-A  
 STA 10+63.14  
 FL=1328.45  
 TC=1332.33  
 Yn=2.75 FT

## **APPENDIX B**

### **Onsite Drainage Calculations**

# MONTANA DEL SOL C-VALUE CALCULATION



TOTAL AREA = 21411 SQ FT

$$\begin{aligned} \text{WEIGHTED C VALUE} &= [(608.40+2025+698.64) + (1989.30)0.90 + (3600+(514.66/2))0.20 + (12375+(514.66/2))0.35]/21411 \\ &= 0.4740 \end{aligned}$$

TO BE CONSERVATIVE, WE PROPOSE A C-VALUE OF 0.52





Flood Control District of Maricopa County  
 Hydrologic Design Manual Rational Method

Computed by: J. CABLE

Date: 12-27-94

LOCATION DATA

Location: 83RD AVE & CALLE LEJOS

Project Name: MONTANA DEL SOL Subarea id: AREA B1

Drainage Area Cover: \_\_\_\_\_

DESIGN DATA

Drainage Area 7.31 acres  
 Watercourse Length 1275.0 feet  
 Top Elevation 1331.0 feet  
 Bottom Elevation 1323.5 feet  
 Slope .00588 feet/feet  
 Roughness Coefficient (Kb) .06813  
 10-Year, 6-Hour Rainfall 2.07 inches

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	6	9	10	15	19	23
C	0.416	0.416	0.416	0.458	0.499	0.520
Tc (min)	22.0	19.3	18.0	16.4	15.4	14.6
i (in/hr)	2.0	2.8	3.4	4.4	5.1	6.0

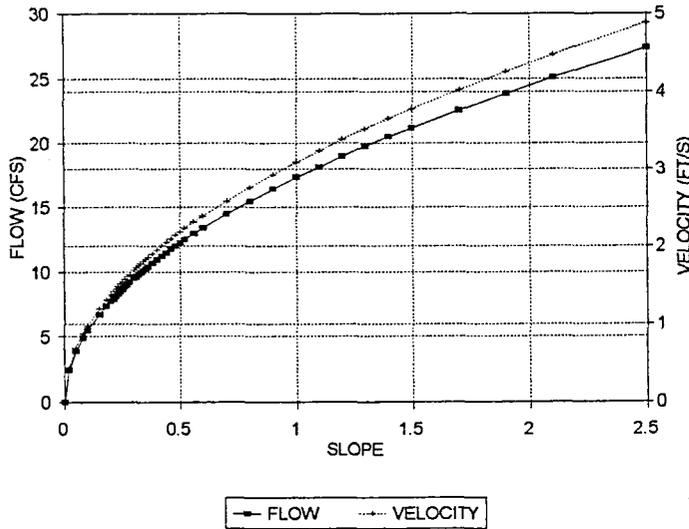
# FULL STREET FLOW CAPACITY CHART 4" ROLL CURB

33.16' WIDTH TO BC

MANNING ROUGHNESS = 0.015  
 CURB HEIGHT = 0.33 FEET  
 CROSSLOPE = 1 TO 50  
 CURB WIDTH = 0.5 FEET  
 F/C OFFSET = 0.55 FEET  
 MAX AREA THIS CURB = 5.6265 SQ FEET  
 STREET WIDTH TO B/C = 33.16 FEET  
 FLOW AREA, A = 5.6077 SQ FEET  
 WETTED PERIMETER, P<sub>w</sub> = 32.35 FEET  
 HYDRAULIC RADIUS, R = 0.173 FEET

PERCENT SLOPE TABLE:

PERCENT SLOPE	VELOCITY	FLOW
0.00	0.00	0.00
0.02	0.44	2.45
0.05	0.69	3.87
0.08	0.87	4.90
0.10	0.98	5.48
0.15	1.20	6.71
0.18	1.31	7.35
0.20	1.38	7.74
0.21	1.42	7.94
0.22	1.45	8.12
0.23	1.48	8.31
0.24	1.51	8.48
0.25	1.54	8.66
0.26	1.57	8.83
0.27	1.60	9.00
0.28	1.63	9.16
0.30	1.69	9.49
0.31	1.72	9.64
0.32	1.75	9.80
0.33	1.77	9.95
0.34	1.80	10.10
0.35	1.83	10.25
0.36	1.85	10.39
0.38	1.90	10.68
0.40	1.95	10.95
0.42	2.00	11.22
0.44	2.05	11.49
0.46	2.09	11.75
0.48	2.14	12.00
0.50	2.18	12.25
0.52	2.23	12.49
0.56	2.31	12.96
0.60	2.39	13.41
0.70	2.58	14.49
0.80	2.76	15.49
0.90	2.93	16.43
1.00	3.09	17.32
1.10	3.24	18.16
1.20	3.38	18.97
1.30	3.52	19.75
1.40	3.65	20.49
1.50	3.78	21.21
1.70	4.03	22.58
1.90	4.26	23.87
2.10	4.48	25.10
2.50	4.88	27.38



SLOPE FOR AREA A = 0.509%  $\Rightarrow Q_{CAP} = 12.25 \text{ cfs} > 10 \text{ cfs}$  OK

SLOPE FOR AREA B1 = 0.382%  $\Rightarrow Q_{CAP} = 10.68 \text{ cfs} > 10 \text{ cfs}$  OK

SLOPE FOR AREA B = 0.382%  $\Rightarrow Q_{CAP} = 10.68 \text{ cfs} < 12 \text{ cfs} \Rightarrow$  NEED VERTICAL CURBS

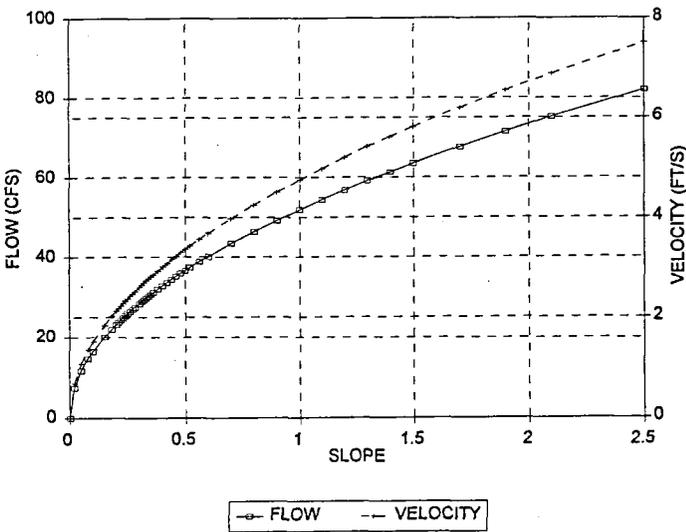
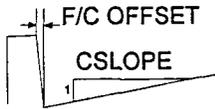
# FULL STREET FLOW CAPACITY CHART 6" VERTICAL CURB

33.16' WIDTH TO BC

MANNING ROUGHNESS = 0.015  
 CURB HEIGHT = 0.5 FEET  
 CROSSLOPE = 1 TO 50  
 CURB WIDTH = 0.5 FEET  
 F/C OFFSET = 0.0833 FEET  
 MAX AREA THIS CURB = 12.5417 SQ FEET  
 STREET WIDTH TO B/C = 33.16 FEET  
 FLOW AREA, A = 10.9205 SQ FEET  
 WETTED PERIMETER, P<sub>w</sub> = 33.01 FEET  
 HYDRAULIC RADIUS, R = 0.331 FEET

PERCENT SLOPE TABLE:

PERCENT SLOPE	VELOCITY	FLOW
0.00	0.00	0.00
0.02	0.67	7.34
0.05	1.06	11.60
0.08	1.34	14.68
0.10	1.50	16.41
0.15	1.84	20.09
0.18	2.02	22.01
0.20	2.12	23.20
0.21	2.18	23.78
0.22	2.23	24.34
0.23	2.28	24.88
0.24	2.33	25.42
0.25	2.38	25.94
0.26	2.42	26.46
0.27	2.47	26.96
0.28	2.51	27.45
0.30	2.60	28.42
0.31	2.65	28.89
0.32	2.69	29.35
0.33	2.73	29.81
0.34	2.77	30.25
0.35	2.81	30.70
0.36	2.85	31.13
0.38	2.93	31.98
0.40	3.00	32.81
0.42	3.08	33.62
0.44	3.15	34.42
0.46	3.22	35.19
0.48	3.29	35.95
0.50	3.36	36.69
0.52	3.43	37.41
0.56	3.56	38.83
0.60	3.68	40.19
0.70	3.98	43.41
0.80	4.25	46.41
0.90	4.51	49.22
1.00	4.75	51.88
1.10	4.98	54.42
1.20	5.20	56.84
1.30	5.42	59.16
1.40	5.62	61.39
1.50	5.82	63.54
1.70	6.19	67.65
1.90	6.55	71.52
2.10	6.88	75.19
2.50	7.51	82.04



SLOPE FOR AREA B = 0.382%  $\Rightarrow Q_{CAP} = 31.98 > 12 \text{ cfs}$  OK

# RIGHT-OF-WAY FLOW CAPACITY CHART

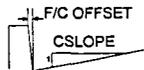
## 4" ROLL CURB

## 33.16' WIDTH TO B/C

## 50' RIGHT-OF-WAY

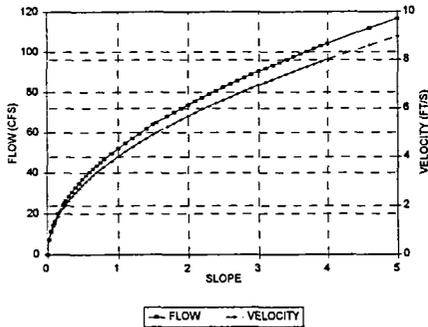
MANNING ROUGHNESS 0.015  
 CURB HEIGHT 0.333 FEET  
 CROSSSLOPE=1 TO 50  
 CURB WIDTH 0.583 FEET  
 F/C OFFSET 0.0833 FEET  
 MAX AREA THIS CURB 5.5722 SQUARE FEET  
 STREET WIDTH TO B/C= 31.16 FEET  
 FLOW AREA, A= 5.5119 SQUARE FEET  
 WETTED PERIMETER, Pw= 30.52 FEET  
 HYDRAULIC RADIUS, R= 0.18 FEET  
 WIDTH TO F/C= 29.99 FEET

RIGHT-OF-WAY DEPTH= 0.15  
 RIGHT-OF-WAY WIDTH= 50  
 ROW FLOW AREA= 12.98701  
 ROW MAX AREA= 14.66535  
 ROW WETTED PERIMETER= 50.52589  
 ROW HYDRAULIC RADIUS= 0.257037



PERCENT SLOPE TABLE:

PERCENT SLOPE	VELOCITY	FLOW
0.00	0.00	0.00
0.02	0.57	7.38
0.05	0.90	11.66
0.08	1.14	14.75
0.10	1.27	16.49
0.15	1.56	20.20
0.22	1.88	24.46
0.24	1.97	25.55
0.26	2.05	26.59
0.30	2.20	28.56
0.35	2.38	30.85
0.40	2.54	32.98
0.45	2.69	34.98
0.50	2.84	36.88
0.55	2.98	38.68
0.60	3.11	40.40
0.65	3.24	42.05
0.70	3.36	43.63
0.75	3.48	45.16
0.80	3.59	46.65
0.90	3.81	49.48
1.00	4.02	52.15
1.10	4.21	54.70
1.20	4.40	57.13
1.30	4.58	59.46
1.40	4.75	61.71
1.50	4.92	63.87
1.55	5.00	64.93
1.70	5.24	68.00
1.80	5.39	69.97
1.90	5.54	71.89
2.00	5.68	73.75
2.10	5.82	75.57
2.20	5.96	77.35
2.30	6.09	79.09
2.40	6.22	80.79
2.50	6.35	82.46
2.60	6.48	84.09
2.70	6.60	85.69
2.80	6.72	87.27
2.90	6.84	88.81
3.00	6.96	90.33
3.10	7.07	91.82
3.20	7.18	93.29
3.30	7.29	94.74
3.40	7.40	96.16
3.50	7.51	97.57
3.60	7.62	98.95
3.70	7.72	100.32
3.80	7.83	101.66
3.90	7.93	102.99
4.00	8.03	104.30
4.60	8.61	111.85
5.00	8.98	116.61



## **APPENDIX C**

### **Retention Calculations**

**Volume Required:**

$$C = 0.52$$

$$P_{100 \text{ yr-2 hr}} = 2.6 \text{ inches}$$

$$\text{Area A} = 411,735 \text{ ft}^2$$

$$\text{Volume A} = 0.52 \times (2.6/12) \times 411,735 = 46,389 \text{ ft}^3$$

$$\text{Area B} = 321,057 \text{ ft}^2$$

$$\text{Volume B} = 0.52 \times (2.6/12) \times 321,057 = 36,172 \text{ ft}^3$$

$$\text{Total Volume Required: } 82,561 \text{ ft}^3$$

**Volume Provided:**

Basin A:

<u>Elevation</u>	<u>Area (ft<sup>2</sup>)</u>	<u>Volume (ft<sup>3</sup>)</u>
1322.20	24927.06	
1322.00	24419.34	4934.64
1321.00	21941.66	23180.50
1320.00	19570.10	20755.88
1319.20	17743.89	<u>14925.60</u>
	<b>Total</b>	<b>63796.62</b>

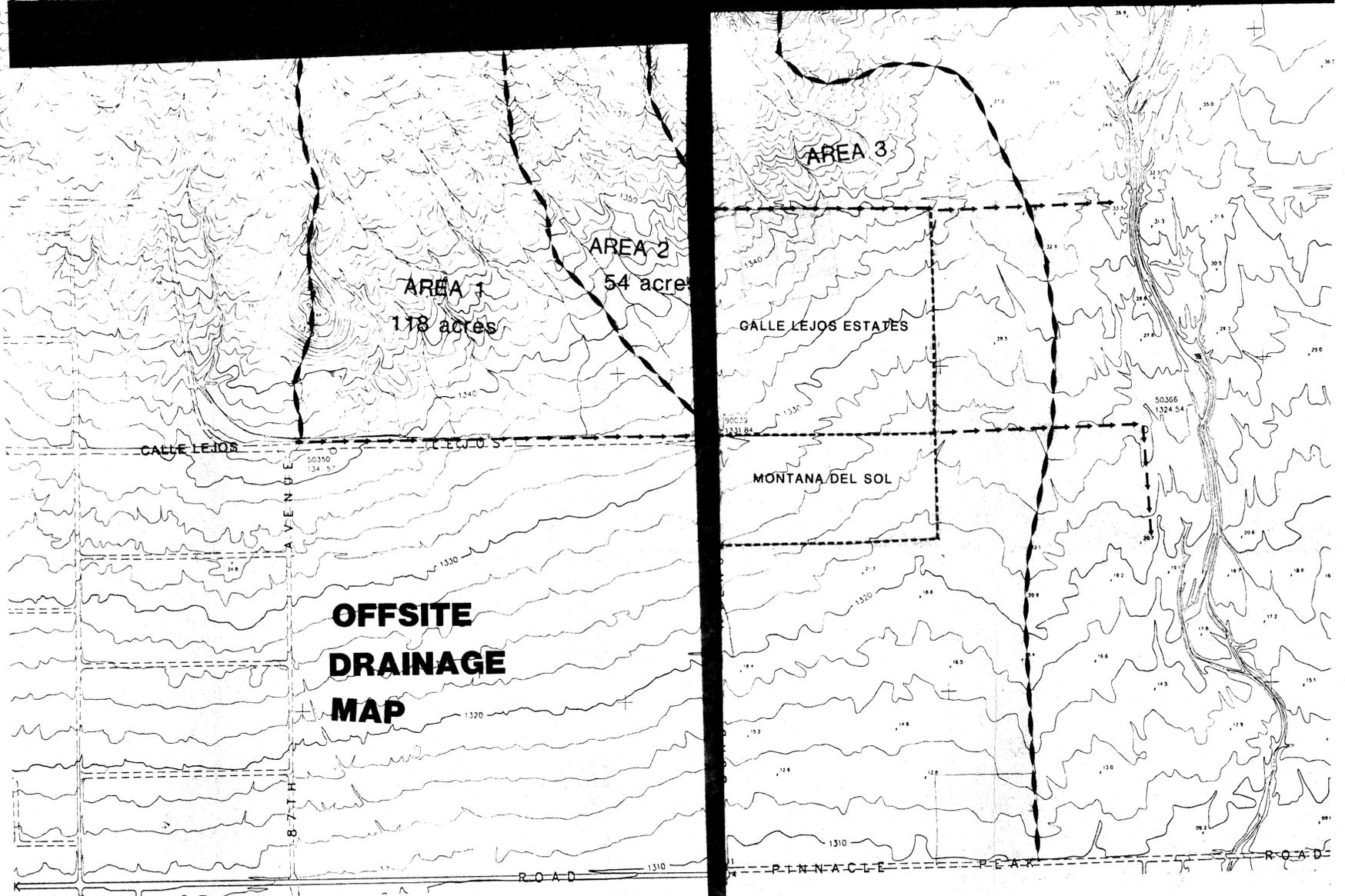
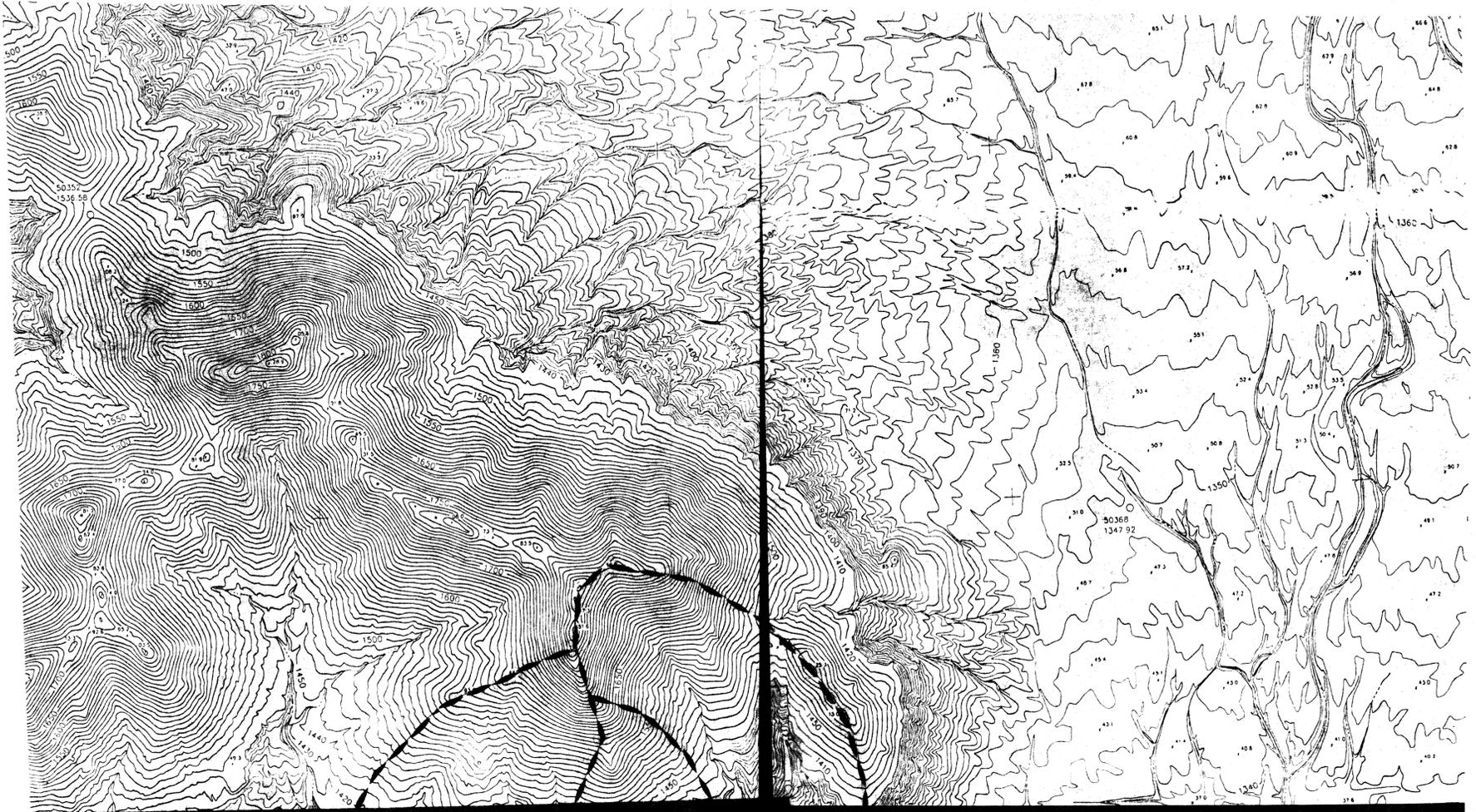
Basin B:

<u>Elevation</u>	<u>Area (ft<sup>2</sup>)</u>	<u>Volume (ft<sup>3</sup>)</u>
1322.20	14317.84	
1322.00	13834.23	2815.21
1321.00	11478.74	12656.49
1320.00	9228.48	10353.61
1319.20	7511.97	<u>6696.18</u>
	Total	<b>32521.48</b>

Total Volume Provided = 96318.1 ft<sup>3</sup> > 82,561 ft<sup>3</sup>

## **APPENDIX D**

### **Drainage Maps**



**OFFSITE  
DRAINAGE  
MAP**

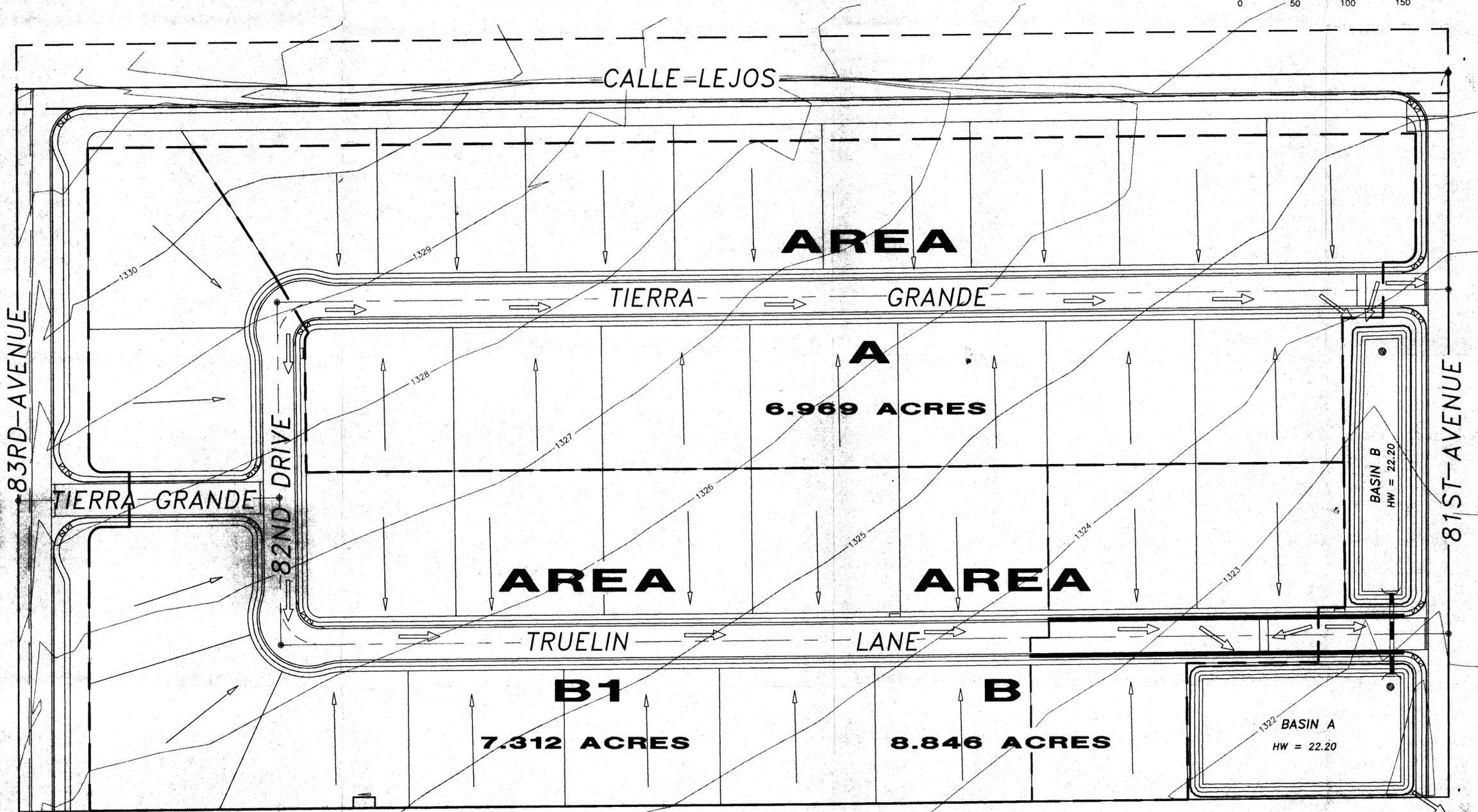
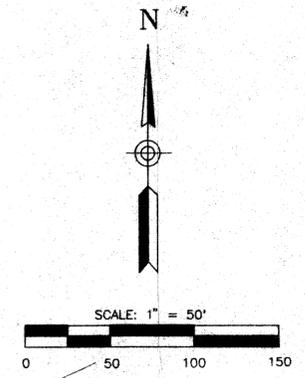
# MONTANA DEL SOL

## ONSITE DRAINAGE MAP

FLOOD CONTROL DISTRICT RECEIVED  
JAN 13 1995

CHENG	P & PM
DEF	REG
ADMIN	LMGT
FINANCE	FILE
C&M	
ENGR	
REMARKS	

PROJECT NO.	93248
DATE	01/07/95
SCALE	1" = 50'
DRAWN BY	SCOTT M. LARSON, P.E.
CHECKED BY	
APPROVED BY	



- LEGEND**
- CONTRIBUTING AREA BOUNDARY
  - VERTICAL CURB SECTION FOR INTERIOR STREET
  - ⇨ STREET FLOW DIRECTION
  - ⇨ LOT FLOW DIRECTION
  - DRYWELL

AMERICAN ENGINEERING CO.  
consulting engineers/surveyors  
21442 NORTH 20TH AVENUE  
PHOENIX, ARIZONA 85027



PROJECT NAME: MONTANA DEL SOL  
PLAN TYPE: ONSITE DRAINAGE MAP



ORIGINAL PLAN DATE: 01/07/95  
LATEST REVISION DATE:

SHEET NUMBER: 1 of 1  
PROJECT NUMBER: 93248

D:\VOC\95\13248\21442\DRG\ONSITE.DWG Sat Jan 7 14:24:42 1995 DAL