HYDROLOGY D19/D9

LOMITA ACRES

D19- D9

2 PLANS

September 26, 1975

D19-D9

Mr. J. W. Bettis
Enchantment Engineering, Inc.
3240D Juan Tabo Blvd. N.E.
Albuquerque, N.M. 87111

RE: DRAINAGE REPORT LOMITA ACRES

Dear Mr. Bettis:

The subject report is approved subject to submitting a grading plan and detailed construction plans.

City policy requires construction of the drainage facilities prior to use of the sewer and water lines.

Very truly yours,

Kleston H. Laws
Assistant City Engineer-Hydrology

KHL/fs

cc: Mr. John Robert

DRAINAGE

LOMITA ACRES

SEPTEMBER, 1975

APPROVED FOR DRAINAGE

24 Sept 75
DATE

K H Lewis ACE Hyd.
SIGNATURE TITLE

CONTINGENCIES _____

ENCHANTMENT ENGINEERING

Scope:

To determine an acceptable method for controlling the rate and volume of runoff resulting from a 100 year frequency storm relative to the proposed Lomita Acres Subdivision.

Location and Terrain:

The area proposed for development lies to the north of Loma del Norte Unit 7, to the west of Loma del Norte Unit 8, to the south of the proposed Loma del Norte Unit 10, and to the east of Wyoming Boulevard N.E. (See Plate 1, Appendix) The slopes on this part of the east mesa range from three (3) to four (4) percent and the ground cover may be classified as sparsely vegetated.

Proposed Development.

Lomita Acres will be developed as R-1 single family residences following the guidelines set forth by the Albuquerque Metropolian Arroyo Flood Control Authority in their July 1972 Drainage Resolution. Approximately half the water falling on

each lot will be RETAINED. This will be accomplished by means of backyard ponding. (See Appendix for typical lot ponding detail. It will be required that flows entering the proposed subdivision, along with runoff generated within the subdivision, be diverted north, through Lomas del Norte, Unit 10, to the Arroyo de Domingo Baca.

Hydrologic Analysis

A One Hundred Year Frequency Rain was used in conjunction with the rational method to compute the flow rate of storm water runoff originating from Lomita Acres and a One Hundred Year six hour rain was used to compute the volume of the runoff. These flows and volumes were computed for both the developed and undeveloped conditions. To implement the use of the rational formula, data was taken from the contour maps included in this report. A table of the data and the results of the hydrologic analysis is presented in the Appendix of the report.

Internal Drainage

Lomita Acres is comprised of four (4) small drainage basins in the undeveloped state. The natural runoff from these basins generates approximately 44 cfs. In the developed state this area will produce 48 cfs.

In computing the runoff after development it was assumed that the back and side yards along with the rear half of the roof will be ponded in the backyard of that lot. (See Appendix for Typical Lot Ponding Detail)

The drainage pattern, after development, along with the accumulated flow and velocity of the runoff for the street system is presented on Plate 3 of the Appendix.

EXTERNAL DRAINAGE

The Approved Drainage Report for Loma del Norte Units 5, 6, 7 and 8, prepared by William Matotan and Associates and dated September, 1973, shows two drainage areas affecting Lomita Acres. The smaller of the two areas comprises 5.4 acres of Loma del Norte Unit 8 and enters Lomita Acres at the southeast corner of the development. The expected runoff generated by this area is 14 cfs and will be transfered in a drainage easement (See Appendix for cross-section) to the street system as shown on Plate 3.

The remaining area affecting Lomita Acres drains approximately 90 acres and produces a concentrated flow, at the intersection of San Francisco and Barstow Road, of 190 cfs. The development of this area of the east mesa calls for storm runoff to be diverted north to intercept the Arroyo de Domingo Baca. In keeping with this proposal the developers and engineers of Loma del Norte Unit 10 have agreed to divert approximately 120 cfs north before it reaches the east boundary of

LOMITA ACRES. THIS WOULD RESULT IN A FLOW OF 70 CFS ENTERING LOMITA ACRES. THIS FLOW WOULD THEN BE CARRIED NORTH THROUGH THE STREET SYSTEM AS SHOWN ON PLATE 3.

RECOMMENDATIONS:

THE CHANNELING OF STORM RUNOFF IN A NORTHERLY DIRECTION GOVERNS THE PRESENT DEVELOPMENT OF LOMITA ACRES. IN ORDER TO CARRY THE EXPECTED RUNOFF FROM A ONE HUNDRED YEAR FREQUENCY STORM IT IS RECOMMENDED THAT ROBERTS STREET, NORTH OF SAN FRANCISCO, BE CONSTRUCTED THIRTY-EIGHT FEET, FACE TO FACE. WITH THIS PROVISION, STORM RUNOFF IS EXPECTED TO OVERFLOW THE TOP OF CURB BY 0.22 ft., HOWEVER THE FLOW WILL STILL BE MAINTAINED IN THE STREET RIGHT-OF-WAY.

Appendix

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

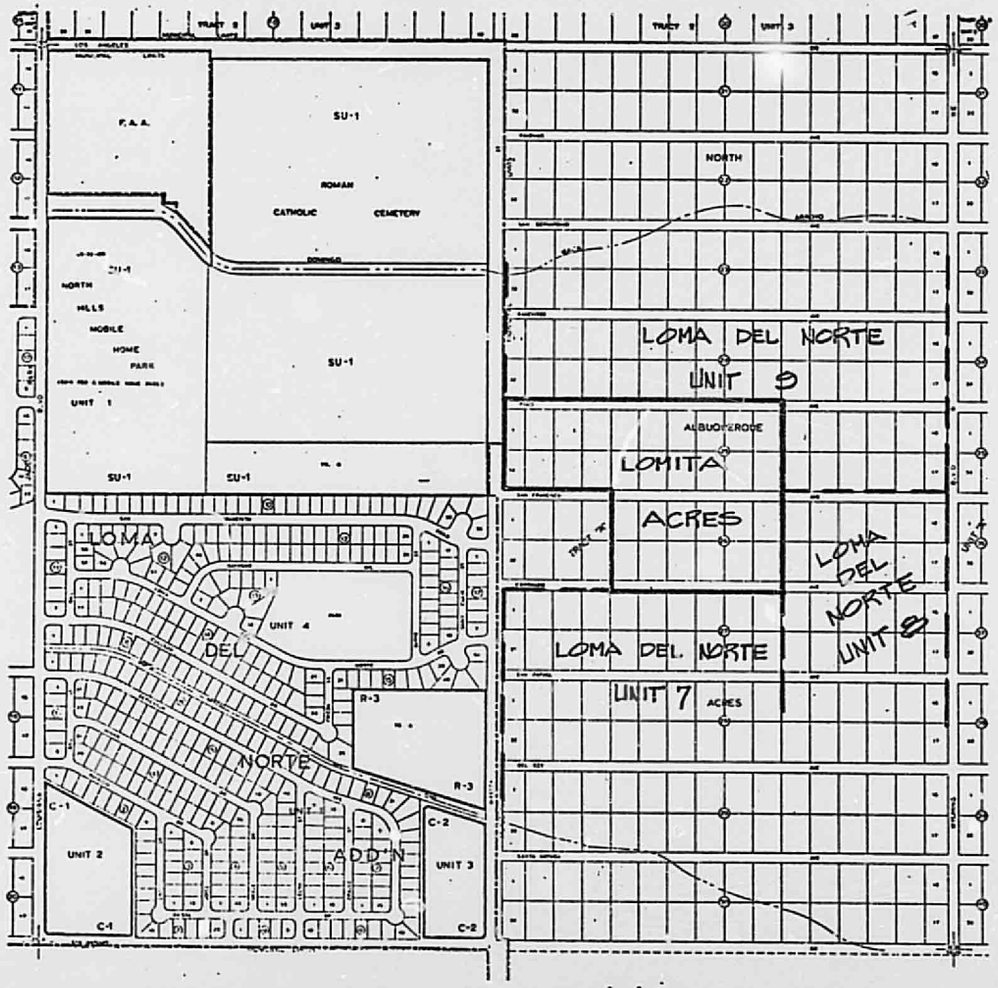


PLATE 1

D-19-Z

Summary of Hydrologic Data

Drainage in Undeveloped State
(Refer to Plate 2)

Drainage Area	Acreage	Q (cfs)	Vol (ac-ft)
1	7.70	13.4	.722
2	6.72	11.7	.63
3	8.09	14.05	.758
4	2.82	4.9	.264
Total	25.33	44.05	2.374

Drainage in Developed State
(Refer to Plate 3)

Drainage Area	Acreage Contributing to Runoff	Q (cfs)	Vol. (ac-ft)
1	2.0	6.43	.28
2	1.23	3.51	.155
3	1.75	5.9	.255
4	0.83	3.52	.135
5	1.33	4.66	.189
6	0.78	2.78	.113
7	1.32	4.73	.189
8	1.88	4.87	.255
9	1.33	4.8	.207
10	0.97	2.55	.11
11	1.58	4.25	.213
Total	15	48 cfs	2.104 ac-ft

CALCULATIONS

The runoff calculations were made using the rational formula. The time of concentration used in the calculations was found by the following empirical formula.

$$TC = \log^{-1}[.3641(B) + .3854\log(L) - .197\log(S) - .3613]$$

WHERE:

S = Average slope of the basin in percent

B = Ground factor.

- Paved = .77
- Bare Soil = 1.52
- Poor Grass Surface = 1.84
- Average Grass Surface = 2.16
- Dense Grass Surface = 2.57

TC = Time of concentration

L = Distance to Furthest Point in the Basin in Feet.

The runoff from developed land was established by first determining the composite ground factor and runoff coefficient then using the rational formula to determine the flows.

Effective Area = Total Area - Retention Area

B_n = Area weighted ground factor

B_n = (B for surface)(Area of surface)/(Effective Area)

Composite Ground Factor = $\sum_{n=1}^{n} B_n$

C_n = Area weighted runoff coefficient

C_n = (C for surface)(Area of surface)/(Effective Area)

Composite Runoff coefficient = $\sum_{n=1}^{n} C_n$

Undeveloped Runoff - Area I

Total Area = 7.7 ac.

B = 1.87

S = 3%

L = 1050 ft

C = .45

$TC = \log^{-1}[.3641(1.87) + .3854\log(1050) - .197\log 3 - .3613]$

$= \log^{-1}[.680 + 1.1643 - .094 - .3613]$

$= \log^{-1}[1.389]$

$= 24$

$I = 189/(TC+25) = 3.86$ in/hr

Runoff = CIA = .45 × 3.86 × 7.7 = 13.4 cfs

Volume = 2.5 × 1/12 × .45 × 7.7 = .72 ac·ft

Undeveloped Runoff - Area II

Total Area = 6.72 ac.

B = 1.87

S = 3.1%

L = 1000 ft

C = .45

$TC = \log^{-1}[.3641(1.87) + .3854\log(1000) - .197\log 3.1 - .3613]$

$= \log^{-1}[.680 + 1.1562 - .0968 - .3613]$

$= \log^{-1}[1.3781]$

TC = 23.8 mins

$I = 189/(TC+25) = 3.87$ in/hr.

Runoff = CIA = .45 × 3.87 × 6.72 = 11.7 cfs

Volume = 2.5 × 1/12 × .45 × 6.72 = .63 ac·ft.

UNDEVELOPED RUNOFF · AREA III

AREA = 8.07 ACRES
B = 1.87
S = 3%
L = 1000 ft
C = .45

$TC = \log^{-1}[.3641(1.87) + .3884 \log 1000 - .197 \log 3 - .3613]$
$= \log^{-1}[.680 + 1.1562 - .094 - .3613]$
$= \log^{-1}[1.3809]$
TC = 24 mins

$I = .187/TC^{.25} = 3.86$ in/hr

RUNOFF = CIA = .45 × 3.86 × 8.07 = 14.05 cfs
VOLUME = 2.5 × 1/12 × .45 × 8.07 = .758 AC.FT

UNDEVELOPED RUNOFF = AREA IV

TOTAL AREA = 2.82 AC.
B = 1.87
S = 3%
L = 990
C = .45

$TC = \log^{-1}[.3641(1.87) + .3884 \log(990) - .197 \log 3 - .3613]$
$= \log^{-1}[.68 + 1.1545 - .094 - .3613]$
$= \log^{-1}[1.3792]$
TC = 24 min
I = 3.86 in/hr

Q = CIA = .45 × 3.86 × 2.82 = 4.9 cfs
VOLUME = 2.5 × 1/12 × .45 × 2.82 = .264 AC.FT
TOTAL RUNOFF = 19.05 cfs
TOTAL VOLUME = 2.374 AC.FT

Developed Runoff - Area 1

TOTAL AREA CONTRIBUTING TO RUNOFF = 2 AC.

Type of Cover	n	Area	B	Bn	C	Cn
Paving	1	.83	.77	.319	.95	.394
Houses	2	.37	.77	.142	.95	.176
Lawns	3	.8	2.57	1.028	.25	.1
TOTAL		2.0		1.489		.67

$TC = \log^{-1}[.3641(B) + .3854 \log(L) - .197 \log S - .3613]$

$B = 1.489$

$S = .031 = 3.1\%$

$L = 640$

$TC = \log^{-1}[.5641(1.489) + .3854 \log 640 - .197 \log 3.1 - .3613]$

$= \log^{-1}[.542 + 1.081 - .097 - .3613] = \log^{-1}[1.1647]$

$TC = 14.6$ mins

$I = \frac{189}{t+25} = 4.8$ in/hr

$Q = CIA = .67 \times 4.8 \times 2 = \underline{6.43}$ cfs

Volume $= 2 \times .67 \times 2.5 \times 1/12 = \underline{0.28}$ AC·FT

Developed Runoff - Area 2

TOTAL AREA CONTRIBUTING TO RUNOFF = 1.23 AC.

Type of Cover	n	Area	B	Bn	C	Cn
Paving	1	.46	.77	.288	.95	.355
Houses	2	.165	.77	.103	.95	.127
Lawns	3	.605	2.57	1.264	.25	.123
		1.23		1.655		.605

$B = 1.655$

$S = 2\%$

$L = 380$ ft.

$TC = \log^{-1}[.3641(1.655) + .3854 \log 380 - .197 \log 2 - .3613]$

$= \log^{-1}[.6026 + .9942 - .0593 - .3613] = \log^{-1}(1.1762)$

$TC = 15$ min

$I = 189/TC + 25 = 4.72$ in/hr

DEVELOPED RUNOFF = Q = CIA = .605 × 4.72 × 1.23
= 3.51 CFS

Volume = .605 × 1.2 × 1/12 × 2.5 = 0.155 AC·FT

DEVELOPED RUNOFF - AREA 3

TOTAL AREA CONTRIBUTING TO RUNOFF = 1.75 AC.

TYPE OF COVER	M	AREA	B	Bm	C	Cm
PAVING	1	.80	.77	.352	.95	.434
HOUSES	2	.35	.77	.154	.95	.190
LAWNS	3	.60	2.57	.881	.25	.086
		1.75		1.387		.71

S = 1.6%, L = 580 FT,

$TC = \log^{-1}[.3641(1.387) + .3854 \log 580 - .197 \log 1.6 - .3613]$
$= \log^{-1}[0.5050 + 1.065 - .0402 - .3613]$
$= \log^{-1} 1.1685$
TC = 14.74 min

$I = 189/TC + 25 = 4.75$ in/hr.

RUNOFF = CIA = .71 × 4.75 × 1.75 = 5.9 CFS
Volume = .71 × 1.75 × 2.5 × 1/12 = 0.258 AC·FT

DEVELOPED RUNOFF - AREA 4

TOTAL AREA CONTRIBUTING TO RUNOFF = 0.83 AC.

TYPE OF COVER	M	A	B	Bm	C	Cm
PAVING	1	.62	.77	.575	.95	.709
LAWN (OTHER)	2	.21	1.84	.465	.3	.076
		.83		1.04		.785

B = 1.04, S = 2.5, L = 560

$TC = \log^{-1}[.3641(1.04) + .3854 \log(560) - .197 \log 2.5 - .3613]$
$= \log^{-1}[.3786 + 1.0591 + .0784 - .3613] = \log^{-1}[.998]$
$= 9.95$ in/hr < 10 USE 10 mins

$I = 189/TC+25 = 189/35 = 5.4$ in/hr.

Runoff $Q = CIA = .785 \times .83 \times 5.4 = \underline{3.52}$ cfs
Volume $= 2.5 \times .785 \times 1/12 \times .83 = \underline{0.135}$ ac·ft.

Developed Runoff - Area 5

Area contributing to runoff = 1.33 ac.

Type of Cover	n	A	B	Bn	C	Cn
Paving	1	.56	.77	.3242	.95	.4
Houses	2	.27	.77	.1563	.95	.193
Lawns	3	.50	2.57	.966	.25	.094
		1.33		1.4465		.684

$B = 1.4465$, $S = 3.4$, $L = 420$

$TC = \log^{-1}[.3641(1.4465) + .3854 \log 420 - .197 \log 3.4 - .3613]$
$= \log^{-1}[.5267 + 1.011 - .1047 - .3613]$
$= \log^{-1}[1.0717]$
$TC = 11.77$ mins.
$I = 189/TC+25 = 5.13$ in/hr.

Runoff $= Q = CIA = .684 \times 5.13 \times 1.33 = \underline{4.66}$ cfs
Volume $= .684 \times 1.33 \times 2.5 \times 1/12 = \underline{0.189}$ ac·ft

Developed Runoff - Area 6

Area contributing to runoff = 0.78 ac.

Type of Cover	n	A	B	Bn	C	Cn
Paving	1	.4	.77	.3948	.95	.487
Houses	2	.1	.77	.0987	.95	.122
Lawns	3	.28	2.57	.9225	.25	.089
		.78		1.416		.698

$B = 1.416$, $S = 1\%$, $L = 250$

$TC = \log^{-1}[.3641(1.416) + .3854 \log 250 - .197 \log 1 - .3613]$
$= \log^{-1}[.5155 + .9241 - 0 - .3613] = \log^{-1}[1.0783]$
$TC = 11.97$ mins
$I = 189/TC+25 = 5.11$ in/hr

Runoff = Q = CIA = .698 × 5.11 × .78 = 2.78 cfs
Volume = .698 × .78 × 2.5 × 1/12 = .113 ac·ft

Developed Runoff - Area 7

Area contributing to runoff = 1.32 ac.

Type of Cover	n	A	B	Bn	C	Cn
Paving	1	.56	.77	.3266	.95	.403
Houses	2	.27	.77	.1575	.95	.194
Lawns	3	.49	2.57	.954	.25	.093
		1.32		1.4381		.69

B = 1.4381 , S = 4% , L = 420

TC = Log⁻¹[.3641(1.4381) + .3854 log 420 - .197 log 4 - .3613]
= Log⁻¹[.5236 + 1.011 - .1186 - .3613] = Log⁻¹[1.0547]
TC = 11.34 min.
I = 189/TC+25 = 5.2 in/hr.

Runoff = Q = CIA = .69 × 5.2 × 1.32 = 4.73 cfs
Volume = 2.5 × 1/12 × .69 × 1.32 = .189 ac·ft

Developed Runoff - Area 8

Area contributing to runoff = 1.88 ac

Type of Cover	n	A	B	Bn	C	Cn
Paving	1	.88	.77	.3604	.95	.944
Houses	2	.2	.77	.0819	.95	.101
Lawns	3	.8	2.57	1.0936	.25	.106
		1.88		1.5359		.651

B = 1.5359, S = .5 , L = 690
TC = Log⁻¹[.3641(1.5359) + .3854 log 690 - .197 log(.5) - .3613]
= Log⁻¹[.5592 + 1.0941 + .0593 - .3613] = Log⁻¹[1.3513]
TC = 22.45 mins
I = 189/TC+25 = 3.98 in/hr
Runoff Q = CIA = .651 × 1.88 × 3.98 = 4.87 cfs
Volume = 2.5 × 1/12 × .651 × 1.88 = .255 ac·ft.

Developed Runoff - Area 9

AREA CONTRIBUTING TO RUNOFF = 1.38 AC.

Type of Cover	m	Area	B	Bm	C	Cm
Paving	1	.64	.77	.557	.95	.44
Houses	2	.29	.77	.162	.95	.199
Lawn	3	.45	2.57	.838	.25	.081
TOTAL -		1.38		1.355		.72

$B = 1.355$, $S = 1.3$, $L = 500$ ft.

$TC = \log^{-1}[.3641(1.355) + .3854 \log 500 - .197 \log 1.3 - .3613]$

$= \log^{-1}[.4933 + 1.0402 - .0224 - .3613]$

$= \log^{-1}[1.1498]$

$TC = 14.12$ mins

$I = 189/TC^{.25} = 4.83$ in/hr.

Runoff $= Q = CIA = .72 \times 4.83 \times 1.38 = \underline{4.8}$ cfs

Volume $= 2.5 \times 1/12 \times .72 \times 1.38 = \underline{.207}$ ac·ft

Developed Runoff - Area 10

AREA CONTRIBUTING TO RUNOFF = .97 AC.

Type of Cover	m	A	B	Bm	C	Cm
Paving	1	.37	.77	.2937	.95	.362
Houses	2	.04	.77	.0317	.95	.039
Lawns	3	.56	2.57	1.4837	.25	.144
TOTAL		.97		1.8091		.545

Length = 340, $S = 4.1$, $B = 1.8091$

$TC = \log^{-1}[.3641(1.8091) + .3854 \log(340) - .197 \log 4.1 - .363]$

$= \log^{-1}[.6587 + .9956 - .1207 - .3613]$

$= \log^{-1}[1.1523]$

$TC = 14.2$ mins.

$I = 189/TC^{.25} = 4.82$ in/hr.

Developed Runoff $= Q = CIA = .545 \times 4.82 \times .97 = \underline{2.55}$ cfs

Volume $= 2.5 \times 1/12 \times .545 \times .97 = \underline{0.11}$ ac·ft.

DEVELOPED RUNOFF - AREA 11

AREA CONTRIBUTING TO RUNOFF = 1.58 AC.

TYPE OF COVER	n	A	B	Bn	C	Cn
PAVING	1	.66	.77	.3216	.95	.397
HOUSES	2	.24	.77	.1169	.95	.144
LAWNS	3	.68	2.57	1.1061	.25	.107
		1.58		1.5446		.648

$B = 1.5446, \; S = .5, \; L = 540$

$TC = \log^{-1}[.3641(1/1.5446) + .3854 \log(540) - .77 \log .5 - .3613]$

$= \log^{-1}[.5623 + 1.053 + .0593 - .3613]$

$= \log^{-1}[1.3133]$

$TC = 20.57$ MINS

$I = 189/TC^{.25} = 4.15$ in/hr.

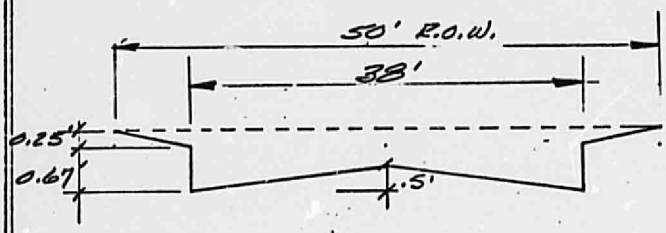
RUNOFF $= Q = CIA = .648 \times 4.15 \times 1.58 = \underline{4.25 \text{ CFS}}$

VOLUME $= 2.5 \times 1/12 \times .648 \times 1.58 = \underline{.213 \text{ AC}\cdot\text{FT}}$

TOTAL DEVELOPED RUNOFF = 48 CFS

TOTAL VOLUME OF RUNOFF = 2.104 AC·FT

ROBERTS STREET - NORTH OF SAN FRANCISCO



TOTAL AREA = 26.96 FT^2 $\qquad$ S = .005

TOTAL P = 51.36 FT. $\qquad$ n = .015

EXPECTED FLOW - 98.04 CFS
OVER FLOW TOP OF CURB BY 0.17 ft

$A = 23.11$ ft^2

$P = 47.52$ ft

$R = A/P = .486 \Rightarrow R^{2/3} = 0.62$

$$Q = \frac{1.486}{.015} \times .62 \times .0707 \times 23.11 = 100.35 \text{ CFS}$$

$$V = Q/A = \frac{100.35}{23.11} = 4.34 \text{ ft/SEC}$$

EXPECTED FLOW = 107.34 CFS
OVER FLOW TOP BY 0.2 ft

$A = 24.52$ FT^2

$P = 48.96$ FT

$R = A/P = .5 \Rightarrow R^{2/3} = .63$

$$Q = \frac{1.486}{.015} \times .65 \times .0707 \times 24.52 = 108.19 \text{ CFS}$$

$$V = Q/A = 4.41 \text{ ft/SEC}$$

EXPECTED FLOW = 113.96 CFS
OVER FLOW TOP OF CURB BY 0.22 ft

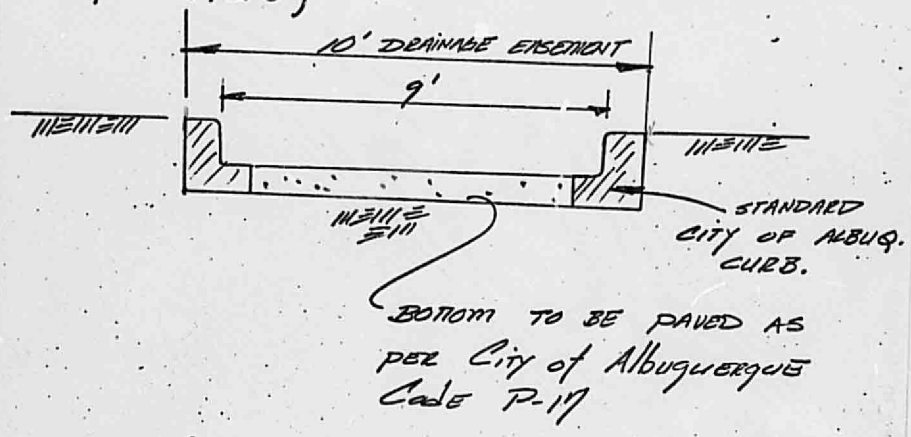
$A = 25.48\ ft^2$
$p = 49.92\ ft$
$R = A/p = .51 \Rightarrow R^{2/3} = .64$

$Q = \frac{1.486}{.015} \times .64 \times .0707 \times 25.48 = 114.21\ cfs$

$V = Q/A = 4.48\ ft/sec.$

Channel Design

Section along southeast lot boundary of Lomita Acres (Flow from 5.4 acres of Loma del Norte Unit 8, Q = 14cfs)



Water depth	= 0.28 ft
Area (A)	= 2.52 ft^2
Hydraulic Radius (R)	= 0.263
Slope	= 2%
Mannings coefficient	= 0.015

$$Q = \frac{1.486}{n} R^{2/3} S^{1/2} A$$

$$Q = \frac{1.486}{0.015} (.265)^{2/3} (.02)^{1/2} (2.52)$$

$$= 14.47 \text{ cfs}$$

$$V = Q/A = 5.74 \text{ ft/sec.}$$

D