

survey. Calculations were carried out from July 15 (8:00 am) to September 30 (7:00 am) in 1995 at the time step of 1 or 2 minutes. Figure B. 24 shows the results of calculated waterlevel in the Middle reach and the Lower reach.

11. DESIGN DISCHARGE

11.1 Rainfall Analysis

Rainfall to determine the design discharge was analyzed in consideration of characteristics of rainfall which would cause flooding in the basin. The following is the principal items to establish the design rainfall:

- Intensity by return period
- Unit and total duration of rainfalls
- Distribution in area
- Pattern of hyetograph

Six (6) rainfall gauging stations which were functioning in September, 1988 are San Francisco Gotera, Beneficio El Papalon, Santiago de Maria, El Sitio, Puerto Parada and Corinto. Among them, San Francisco Gotera, El Papalon and Santiago de Maria have continuous daily data for more than 30 years. Probability study was made for these stations. The annual maximum rainfalls of these stations are listed in Table B. 8 for various duration of 1, 2, 3, 4, 5, 7, 14 and 30 days.

Basin mean probable rainfall was calculated based on the point rainfalls at these 3 stations applying Thiessen ratios of 0.300 for San Francisco Gotera, 0.509 for El Papalon and 0.191 for Santiago de Maria as follows:

(Probable Basin Mean 7-day Rainfall)

Return period (yr.)	Basin mean rainfall (mm)	Return period (yr.)	Basin mean rainfall (mm)
100	362.2	5	240.9
50	335.5	2	191.4
20	299.9	1.05	120.0
10	271.7		

Unit duration of rainfall was set to be 6 hours so that the flood peak might not be overshadowed, considering the concentration time at Villerias which is the upper-end station of

the runoff model. On the other hand, total duration of consecutive rainfall was set to be 7 days based on the lag time of flood wave at Las Conchas which is the lower-end station of the flood flow model. Figure B. 16 shows that annual variations of daily discharge and daily rainfall at major stations in 1975.

The rainfall distribution in area was studied for annual maximum 1-day and 7-day rainfalls of past floods in the basin. Reduction curve of point rainfall is shown in Figure B. 9.

Runoff calculation was preliminarily carried out to examine the effect of hyetograph patterns to runoff peak, using rainfall patterns of the biggest three floods in 1988, 1992 and 1982 for 10- and 100-year return periods. According to the calculation, it is confirmed that the rainfall pattern of the 1988-flood gives the largest runoff at any points between Villerias to river mouth as shown below:

(Comparison of Peak Runoffs for Different Rainfall Patterns)

Location	Runoff for 10-yr. Rainfall (m ³ /s)			Runoff for 100-yr. Rainfall (m ³ /s)		
	Sep.1988	Sep.1992	Sep.1982	Sep.1988	Sep.1992	Sep.1982
Villerias	910	690	670	1,410	970	990
Moscoso	1,020	710	710	1,600	990	1,050
El Delirio	1,230	690	880	2,010	1,220	1,420
Vado Marin	1,320	740	950	2,190	1,310	1,580
Las Conchas	1,470	790	1,120	2,470	1,370	1,900
River mouth	1,480	790	1,130	2,480	1,370	1,910

11.2 Design Rainfall

Daily rainfall distributions of the 1988-flood (10-16 September) at 4 rainfall stations available in the basin (refer to Table B. 20) were selected as the basic hyetographs for design discharge calculation by the following reasons:

The 1988 flood is one of the biggest flood in the basin. Seven-day rainfall of the 1988 flood was evaluated to be 50-year flood.

The rainfall peak of the 1988 flood occurred at the latter portion of the hyetograph, which is apt to heighten the runoff peak more.

According to comparative study of hietograph pattern, the rainfall pattern in 1988 flood was confirmed to yield the largest runoff at any sections between Villerias to the river mouth.

Design rainfall hietograph was established (as shown in Figure B. 25) based on the result of rainfall analysis as follows:

Unit duration of rainfall:	6 hours
Total duration of consecutive rainfall:	7 days
Pattern of basic hietograph:	Daily rainfall patterns of the 1988 flood at San Francisco Gotera, Beneficio El Papalon, Santiago de Maria, El Sitio, Puerto Parada and Corinto stations.
Peak rainfall:	Six-hour rainfalls at the rainfall peak were adjusted so as to be the specified probable rainfall height.
Total rainfall:	Six-hour rainfalls during 7 days were proportionally adjusted, except for the peak, so that the total 7-day rainfall should be the specified probable rainfall depth.

The design rainfall for 10-year return period is shown in Table B. 21.

11.3 Design Discharge Distribution

In order to discuss features of flood control master plan, design discharge distribution was calculated for the cases of the with- and without- project conditions.

Design discharge distribution under the without-inundation condition is called here "discharge without inundation".

11.3.1 Discharge Without Inundation

The discharge without inundation was calculated based on the 1.05, 2, 5, 10, 20, 50, 100-year probable rainfalls under the following conditions. The hydrographs at respective sections and the discharge distribution are shown in Figure.B.26 and Figure.B.27, respectively.

Basin: Future condition

Channel: Future condition without any overflow

Runoff retention function of the existing Lake Olomega and Lake Jocotal is not taken into account.

Land use for the design was set to consider the expected spread of urban area from the land use in 1996.

Land use in the Basin for the design (Unit:%)

Land use	Design	Land use	Design
Urban area	1.7	Fruits	0.4
Basic grain	4.9	Vegetable	0.4
Pasture	64.7	Forest	14.7
Coffee	6.2	Water	1.6
Sugar cane	1.7	Lava	1.2
Henequen	2.3		

11.3.2 Discharge With Floodwater Storage Facilities

Discharge with floodwater storage facilities such as Dam, Lake Olomega and Lake Jocotal was calculated for the discussion of alternatives. The details on these simulation are described in Data Book.

Table B.1 LIST OF METEOROLOGICAL OBSERVATORIES IN AND AROUND THE SAN MIGUEL RIVER BASIN

Index	Name of Station	Longitude West	Latitude North	Elevation +MSL
U-6	Santiago de Maria	88-28.3	13-29.1	920
M-6	El Papalon	88-07.6	13-26.4	80
N-15	La Union	87-52.9	13-19.9	95
Z-2	San Francisco Gotera	88-06.4	13-41.8	250
S-10	Ilopango	89-07.1	13-41.9	615

Table.B.2 LIST OF RAINFALL GAUGE STATION IN AND AROUND STUDY AREA

No	Code	Station Name	Latitude	Longitude	Elevation(MSL)	Type	Open	Close
1	M02	San Miguel-Fenadesal	13.29	88.10	105	A	1931	1987
2	M04	Lolotique	13.33.4	88.21.2	675	A	1970	1987
3	M05	Ciudad Barrios	13.45.9	88.16.3	860	A	1970	1987
4	M06	Beneficio El Papalon	13.27	88.07	80	B	1960	-
5	M07	San Jorge	13.25	88.21	330	A	1962	-
6	M12	Canton La Lava	13.21.3	88.14.9	40	A	1964	1978
7	M14	Hacienda San Jose	13.18	88.11	45	A	1966	1979
8	M15	Beneficio El Sitio	13.3	88.12	140	A	1959	-
9	M16	Chapeltique	13.38	88.16	190	A	1968	-
10	M17	Hacienda El Canal	13.19	88.18	30	A	1970	1980
11	M18	Sesori	13.43	88.22	195	B	1970	-
12	N01	Olomega	13.18.7	88.01.7	70 or 80	A	1931	1987
13	N11	Yucuaiquin	13.33	88.00	460	A	1967	-
14	N14	El Carmen	13.21	88.00	105	A	1969	1979
15	N16	San Alejo	13.26	87.58	170	A	1970	-
16	U04	Usulután	13.20.4	88.26.3	75	A	1931	1987
17	U06	Santiago de Maria	13.29	88.28	920	B	1959	-
18	U08	Beneficio San Maurici	13.26	88.29	550	A	1959	1982
19	U13	Jucuaran	13.15.5	88.14.8	764	A	1970	-
20	U14	Puerto Parada	13.15.2	88.26.6	2	A	1970	1987
21	Z02	San Francisco Gotera	13.41.8	88.05.4	250	B	1970	1987
22	Z05	Corinto	13.48	87.58	820	A	-	-
23	Z06	Jocoro	13.37	88.02	250	A	1969	1995
24	Z08	Osicala	13.48	88.09	560	A	1962	1995

Remark: Type A is Pluviometer.

Remark: Type B is Self-recording rain gauge

Table.B.3 LIST OF STREAM GAUGE STATION IN STUDY AREA

No	Code	Station Name	Latitude	Longitude	Item	Elevation(MSL)	Open	Close	Remark
1	48-01-01	San Miguel at Moscoso	13.26	88.09	H,Q	76.02	Jul-58	1978	
2	48-01-02	San Miguel at Vado Marin	13.18	88.17	H,Q	18.78	May-59	1981	Reopen in 1994
3	48-01-03	San Miguel at La Canoa(El Delirio)	13.20	88.09	H,Q	-	May-62	Jun-05	
4	48-01-04	San Miguel at Las Conchas	13.17	88.25	H,Q	15.23	Jul-63	1982	
5	48-01-05	San Miguel at Villerias	13.31	88.11	H,Q	87.43	Jul-65	1980	Reopen in 1995
6	48-02-01	San Esteban at La Reforma	13.32	88.13	H,Q	206.57	Jul-65	1978	
7	48-03-01	Lake Olomega at Puerto Viejo	13.18	88.03	H	63.58	Sep-66	1982	
8	48-04-01	Taisihuat at Hato Nuevo	13.29	88.09	H,Q	92.87	Mar-67	May-77	

H: Waterlevel(Selfrecording)

Q: Discharge(Converted from H)

Table.B.4 MONTHLY METEOROLOGICAL DATA

(1) Temperature(Cels)

Name of Station	Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
Hopango	Maximum	31.5	31.5	32.0	33.4	33.9	29.4	39.2	29.9	29.1	29.0	29.0	29.5	30.5
	Minimum	15.5	15.5	17.5	18.8	19.8	19.6	19.1	19.1	19.2	19.0	17.8	16.7	18.2
	Median	22.1	22.6	23.8	24.4	24.2	23.3	23.2	23.1	22.8	22.7	22.3	21.9	23.0
Santiago de María	Maximum	28.6	29.9	31.0	30.9	29.3	28.0	28.7	28.9	27.8	27.8	27.7	27.9	28.9
	Minimum	16.1	16.2	15.5	18.1	18.5	18.3	18.2	18.1	18.0	18.1	17.3	16.5	17.5
	Median	21.2	21.6	22.5	22.9	22.5	21.9	22.6	22.3	21.5	21.5	21.4	21.1	21.9
El Papalon	Maximum	35.1	36.9	34.2	33.0	35.9	33.6	34.5	34.3	32.9	32.8	33.9	35.1	35.2
	Minimum	18.2	19.1	20.8	22.3	22.9	22.3	21.8	21.9	21.0	21.6	19.3	19.6	20.8
	Median	26.9	27.0	28.3	29.0	28.2	26.9	26.8	26.7	25.9	25.8	25.8	25.8	26.9
La Unión	Maximum	34.4	35.4	28.3	36.7	34.8	33.3	34.4	33.9	33.7	32.9	33.5	34.0	33.5
	Minimum	21.9	22.6	23.7	24.6	24.2	23.4	23.4	23.1	22.7	22.7	22.4	22.4	23.1
	Median	28.2	27.9	29.0	29.5	28.7	27.6	28.2	27.6	26.7	26.8	27.2	27.2	27.9
San Francisco Cetera	Maximum	34.8	35.6	36.9	37.1	34.7	32.4	33.3	33.0	31.8	32.0	33.1	34.2	34.1
	Minimum	18.7	19.2	21.1	22.1	22.6	22.0	21.4	21.6	21.5	21.4	20.1	18.9	20.9
	Median	25.8	26.5	27.9	28.6	27.4	26.0	26.3	25.9	25.3	25.4	25.6	25.5	26.4

Source: MAG, Almanaque Salvadoreño 1996

(2) Humidity (%)

Name of Station	Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
Hopango	median	67	68	70	71	82	85	82	83	85	83	75	70	76.9
	minimum	13	10	12	11	11	25	16	22	24	26	16	16	16.8
Santiago de María	median	67	65	65	71	80	83	75	78	85	83	75	70	73.8
	minimum	10	10	4	11	17	15	21	22	23	26	27	15	16.8
El Papalon	median	59	58	58	62	71	78	72	76	82	82	75	65	69.8
	minimum	12	12	13	13	20	21	19	19	31	28	20	15	18.6
La Unión	median	56	56	56	58	69	75	68	71	78	78	67	59	65.8
	minimum	20	13	13	11	16	13	20	15	25	26	18	19	17.4
San Francisco Cetera	median	56	53	55	58	69	76	71	73	80	79	69	60	66.6
	minimum	17	15	11	10	13	22	15	13	17	24	18	18	16.1

Source: MAG, Almanaque Salvadoreño 1996

(3) Rainfall (mm)

Name of Station	Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Hopango	Mean	4	3	9	44	152	255	327	365	341	239	36	9	1754
Santiago de María	Mean	1	4	11	46	189	320	257	279	404	269	73	12	1865
El Papalon	Mean	1	2	1	1	155	289	201	225	301	200	49	5	1431
La Unión	Mean	1	0	8	33	219	263	178	213	361	246	47	6	1525
San Francisco Cetera	Mean	2	4	8	63	254	374	255	283	428	318	51	8	2648

Source: MAG, Almanaque Salvadoreño 1996

Table B.5 MAXIMUM RAINFALL DEPTH (mm) BY DURATION AT SANTIAGO DE MARIA

Year	1day	Month	Day	2day	Month	Day	3day	Month	Day	4day	Month	Day	5day	Month	Day	7day	Month	Day	14day	Month	Day	30day	Month	Day
1963	97.0	11	9	188.8	11	10	246.8	11	10	359.7	11	10	259.7	11	10	264.7	11	10	287.5	11	10	442.4	9	18
1964	117.0	7	24	137.5	7	25	161.7	7	24	182.2	7	25	200.8	7	25	236.0	7	27	298.2	7	31	477.2	7	27
1965	149.3	9	26	183.9	9	26	208.4	9	27	221.8	9	27	263.1	9	26	297.9	9	30	476.4	9	30	681.5	10	2
1966	99.1	7	13	153.3	7	14	164.2	7	14	180.6	7	14	213.1	7	14	260.4	7	14	321.8	7	14	629.3	7	14
1967	77.8	9	5	95.7	6	6	121.8	6	6	159.6	6	6	190.8	6	6	225.9	6	10	347.3	6	13	504.6	6	30
1968	77.9	10	17	142.7	10	18	165.9	10	19	172.2	10	19	179.9	10	21	189.8	10	22	254.2	6	11	474.0	6	27
1969	132.3	8	19	183.4	9	5	206.3	9	5	213.3	8	20	229.8	9	8	278.4	9	9	377.9	8	19	597.5	9	4
1970	84.2	9	21	95.4	9	1	132.4	9	21	147.3	7	15	173.7	9	5	212.0	9	6	325.2	9	7	521.0	9	23
1971	78.2	5	30	108.0	5	30	109.7	9	23	138.2	9	25	182.2	9	25	209.9	9	25	227.1	10	2	489.3	10	18
1972	69.1	6	16	90.3	6	17	96.5	9	25	104.1	9	26	114.0	9	27	138.2	9	29	221.6	10	4	409.9	10	21
1973	81.6	8	22	121.5	8	31	167.4	8	31	183.6	8	31	186.5	8	31	206.6	9	5	329.5	9	1	526.4	9	20
1974	232.1	9	20	344.8	9	21	355.5	9	21	359.5	9	22	362.9	9	22	370.9	9	25	460.6	9	21	603.6	10	4
1975	69.6	7	8	98.4	9	25	130.8	9	25	146.9	9	24	192.2	9	25	198.4	9	25	316.9	10	4	575.7	10	3
1976	73.0	8	29	123.8	6	13	134.1	6	13	172.3	10	8	174.0	10	8	228.6	10	8	318.3	9	5	478.2	9	15
1977	119.0	5	31	182.0	6	1	189.7	6	1	214.9	6	3	233.6	6	4	362.7	6	6	495.2	6	10	668.3	6	23
1978	98.3	9	19	111.0	9	19	174.5	9	21	187.2	9	21	192.6	9	21	205.4	9	24	281.4	7	15	493.6	7	31
1979	156.3	9	12	219.7	9	13	244.7	9	14	248.1	9	14	251.4	9	15	288.9	9	18	431.2	9	14	676.3	9	30
1980	53.1	9	14	67.8	10	7	83.7	10	8	89.9	10	7	109.2	10	10	134.1	10	8	215.6	10	10	447.6	10	8
1981	111.1	5	5	122.8	10	3	221.0	5	7	232.2	5	7	232.2	5	7	233.2	5	7	279.7	9	19	511.3	9	19
1982	155.3	9	19	268.9	9	20	291.1	9	20	299.2	9	20	312.0	9	20	349.7	9	20	429.6	9	25	595.8	10	11
1983	59.4	8	20	66.9	8	29	85.1	8	22	98.0	8	23	98.0	8	23	98.8	8	23	194.3	9	1	327.2	9	17
1984	66.6	7	11	76.1	8	13	100.8	9	3	134.5	8	23	135.2	8	23	153.8	9	6	240.6	9	11	454.6	9	18
1985	194.1	11	2	306.2	11	2	337.3	11	3	354.8	11	4	363.5	11	4	371.8	11	5	405.2	11	5	500.5	11	4
1986	81.6	5	26	110.7	5	31	154.4	6	1	187.8	6	1	225.0	6	1	307.4	6	1	370.0	6	3	544.3	6	23
1987	90.3	8	4	150.8	8	4	154.4	8	5	170.0	8	6	185.1	8	7	219.9	8	4	304.9	8	6	446.4	8	8
1988	119.6	6	21	199.2	9	16	248.6	8	28	267.2	8	28	272.1	8	29	370.0	8	28	477.2	8	28	785.7	8	29
1989	148.7	9	16	213.6	9	17	244.7	9	17	249.1	9	17	249.1	9	17	276.9	9	20	471.6	9	24	783.9	9	25
1990	127.8	5	24	132.2	5	25	132.2	5	25	152.7	5	27	174.5	5	28	235.2	5	30	360.1	5	31	490.5	6	22
1991	76.4	8	31	102.8	8	31	102.8	8	31	104.6	9	2	127.0	6	28	154.2	6	28	272.1	7	2	394.4	7	8
1992	126.5	10	3	132.2	9	30	213.4	10	5	213.6	10	6	258.7	10	3	345.6	10	5	505.2	10	5	795.5	10	5
1993	99.5	6	19	147.2	9	19	152.0	9	19	156.8	9	20	201.3	9	19	241.0	9	19	317.6	9	26	529.6	9	21
1994	71.7	9	27	119.1	9	27	152.7	9	28	171.0	9	28	175.1	9	29	203.4	9	27	330.5	9	28	526.2	10	13
1995	93.0	10	18	145.0	8	17	166.3	8	19	229.6	8	19	268.1	8	20	332.2	8	22	510.4	8	29	744.8	9	11

Table.B.6 MAXIMUM RAINFALL DEPTH (mm) BY DURATION AT EL PAPALON

Year	1day	Month	Day	2day	Month	Day	3day	Month	Day	4day	Month	Day	5day	Month	Day	7day	cont.	Day	14day	Month	Day	30day	Month	Day
1964	50.6	10	16	95.5	6	4	118.4	10	17	123.7	10	18	121.9	10	17	147.1	10	21	167.4	10	20	321.0	7	25
1965	78.8	6	8	110.3	7	30	114.7	5	29	142.3	5	31	182.2	6	1	215.8	6	3	328.4	6	10	536.5	6	17
1966	66.0	8	8	85.0	6	21	109.6	6	21	114.3	7	11	143.6	6	21	167.6	7	13	213.6	6	26	372.0	7	13
1967	N/A																							
1968	N/A																							
1969	N/A																							
1970	80.0	4	15	83.9	8	27	103.3	8	28	119.9	7	15	127.5	7	15	155.0	6	22	239.1	6	23	468.4	6	23
1971	70.9	5	29	88.0	8	13	131.4	9	11	149.6	9	11	155.1	9	12	156.3	9	12	249.3	9	12	431.9	10	7
1972	75.8	6	6	102.1	6	7	104.6	7	23	125.5	10	2	153.5	10	2	173.0	10	8	319.8	10	6	454.6	10	21
1973	73.1	8	31	114.9	6	17	131.4	6	6	158.1	8	31	170.5	8	31	207.5	9	20	329.2	6	17	530.9	9	20
1974	215.3	9	20	290.4	9	21	292.7	9	21	295.2	9	23	297.5	9	23	298.4	9	23	418.8	9	21	546.4	9	22
1975	59.6	9	6	92.5	10	1	112.2	10	2	133.1	8	20	139.0	9	9	172.2	9	12	258.7	10	4	473.7	10	4
1976	141.6	6	13	170.3	6	13	214.7	6	13	216.6	6	13	216.6	6	13	222.7	6	13	319.6	6	25	489.7	6	28
1977	49.9	6	6	59.1	6	7	80.9	6	8	112.4	6	9	117.7	6	9	127.5	6	9	189.6	6	9	273.6	6	27
1978	186.9	9	21	195.3	9	21	202.8	9	21	203.7	9	22	224.1	9	21	225.8	9	23	281.0	9	30	435.3	9	21
1979	73.9	8	20	124.2	8	21	163.6	8	22	166.0	8	23	171.6	8	22	197.2	8	25	338.6	9	2	513.3	9	14
1980	116.5	6	13	134.1	6	13	176.8	7	23	220.4	7	24	250.6	7	24	258.4	7	27	399.6	6	23	626.4	6	25
1981	98.6	5	5	113.3	5	5	148.1	5	7	162.8	5	7	207.3	5	5	256.8	5	7	290.4	7	6	435.7	7	15
1982	175.4	9	19	212.4	9	19	242.2	9	19	244.2	9	19	274.1	9	20	308.7	9	20	388.6	9	29	577.2	10	8
1983	66.7	8	28	98.2	8	29	115.4	8	30	148.3	8	31	153.9	9	1	154.9	9	3	242.6	9	10	407.7	9	26
1984	76.0	7	23	103.3	7	24	103.7	7	25	127.2	7	24	144.9	7	24	187.1	7	29	253.0	8	1	354.8	7	29
1985	207.7	11	2	221.1	11	3	228.1	11	3	240.7	11	3	240.9	11	4	249.8	11	5	292.2	11	3	397.2	8	15
1986	76.3	5	20	93.8	8	13	105.8	5	22	142.8	9	3	151.4	9	4	183.5	9	6	228.8	6	1	355.5	9	6
1987	136.5	8	4	161.2	8	4	166.9	8	6	210.0	8	7	234.7	8	7	247.7	8	4	386.8	8	7	539.2	8	8
1988	221.6	9	16	278.2	9	16	283.3	9	16	312.1	8	29	330.2	8	29	339.9	8	29	404.2	8	29	711.1	9	23
1989	154.9	6	5	193.9	6	6	204.7	6	6	243.8	7	29	245.1	7	30	245.1	7	30	360.9	9	17	622.1	10	1
1990	78.9	11	6	105.3	11	6	106.6	11	7	113.7	10	22	119.6	10	22	143.2	10	22	224.0	9	24	363.5	10	3
1991	64.0	8	31	117.0	6	28	124.9	6	28	131.8	6	28	159.6	6	28	244.0	6	28	350.2	6	28	404.7	7	4
1992	114.4	9	29	170.8	9	29	231.8	9	29	280.2	9	29	335.0	9	29	340.2	9	30	448.8	9	30	608.3	10	8
1993	193.0	4	27	196.8	4	27	197.0	4	28	197.0	4	28	198.3	4	30	215.4	5	31	310.3	6	1	446.2	10	1
1994	70.7	9	27	104.6	9	27	131.8	9	28	156.2	9	28	166.9	9	29	167.3	9	29	215.0	10	8	353.2	10	7
1995	87.5	10	18	105.8	10	19	121.6	6	26	126.4	6	27	131.6	10	22	179.3	9	17	281.9	9	17	428.4	10	3

Table.B.7 MAXIMUM RAINFALL DEPTH (mm) BY DURATION AT SAN FRANCISCO GOTERA

Year	1day	Month	Day	2day	Month	Day	3day	Month	Day	4day	Month	Day	5day	Month	Day	7day	Month	Day	14day	Month	Day	30day	Month	Day
1964	99.3	8	29	113.5	8	30	175.7	8	31	193.4	9	1	215.3	8	31	256.2	9	11	352.7	9	11	617.6	9	13
1965	75.8	10	2	92.9	10	3	128.1	9	19	143.2	9	19	157.1	9	20	206.3	9	23	289.0	9	23	562.3	10	14
1966	93.9	5	12	116.5	7	10	167.9	7	10	169.9	7	10	215.5	7	12	256.5	7	12	327.8	6	26	595.6	7	12
1967	106.8	10	5	152.4	10	5	165.6	9	11	169.7	9	12	186.3	9	13	239.6	10	10	363.2	10	11	618.5	10	6
1968	84.1	8	13	95.0	8	14	107.3	8	15	118.0	8	14	131.2	10	17	161.1	9	4	266.5	10	6	501.1	10	18
1969	106.6	9	30	128.4	9	30	129.7	10	1	131.9	9	24	148.1	5	17	217.7	10	6	333.2	10	6	569.3	10	18
1970	92.9	7	13	130.4	5	17	130.9	5	17	136.0	10	12	159.4	10	4	218.6	10	4	354.9	10	4	588.7	10	12
1971	182.2	5	19	189.7	5	19	205.7	5	19	205.7	5	19	205.7	5	19	217.4	5	24	291.5	10	17	483.2	6	15
1972	65.0	5	29	75.9	8	29	104.9	8	29	117.9	9	28	130.3	9	28	149.4	9	29	234.7	10	2	337.7	10	14
1973	141.5	5	22	146.3	5	22	168.8	5	22	177.0	5	22	192.7	10	27	249.3	9	22	406.0	6	22	750.1	10	11
1974	103.0	9	20	133.0	9	21	140.3	9	21	151.5	9	21	164.4	9	21	168.5	9	23	273.9	9	21	462.1	10	5
1975	72.8	9	11	110.6	7	23	129.1	7	23	141.7	7	25	162.4	7	26	184.4	9	12	318.5	9	24	529.3	9	25
1976	90.0	6	13	135.1	6	13	155.8	6	13	162.6	6	13	191.5	6	6	228.6	6	7	393.3	6	13	650.0	6	23
1977	75.4	6	5	134.9	6	1	138.6	6	2	157.7	6	8	175.3	6	9	260.8	6	6	360.7	6	11	473.0	6	23
1978	80.3	7	13	114.1	8	31	143.0	9	29	161.7	9	30	191.7	4	26	235.4	9	30	366.1	9	30	612.1	9	28
1979	89.4	5	14	133.6	4	24	172.2	4	26	218.8	4	26	219.0	4	26	289.9	4	29	357.7	5	3	582.5	9	14
1980	111.1	9	27	140.0	8	15	162.3	9	22	189.3	6	13	211.2	6	13	247.9	9	27	384.2	6	23	642.1	10	8
1981	107.4	5	5	123.2	5	5	135.2	5	7	151.0	5	7	152.3	5	7	152.6	10	13	264.6	10	13	448.4	10	13
1982	120.0	6	12	172.2	6	12	193.0	6	12	221.0	6	12	232.6	6	12	276.7	5	28	395.9	5	31	777.5	6	16
1983	82.7	10	1	131.9	10	1	133.2	10	2	136.5	10	22	205.4	10	24	232.6	10	6	333.1	10	7	663.4	10	25
1984	66.2	7	31	100.9	8	1	110.4	8	2	137.8	8	3	137.8	8	3	167.2	8	3	281.3	8	3	464.2	11	1
1985	144.6	9	19	176.6	9	19	196.8	9	19	229.0	9	19	238.6	9	19	316.6	9	19	401.2	9	19	711.5	9	19
1986	73.4	9	28	140.9	9	28	156.2	9	28	158.5	9	29	161.0	9	28	183.4	9	28	254.1	10	9	388.3	10	25
1987	83.4	8	4	91.6	8	4	91.6	8	4	128.4	8	7	139.8	8	8	150.7	8	9	241.4	6	19	407.9	6	19
1988	122.2	9	16	169.8	9	16	203.5	8	28	266.9	9	16	340.3	9	16	388.0	9	16	446.4	9	23	798.7	9	16
1989	91.6	5	24	134.1	8	31	192.6	7	28	250.5	7	29	250.5	7	29	269.9	7	31	342.1	9	4	606.1	9	10
1990	93.0	10	23	176.8	10	23	213.8	10	24	215.7	10	24	223.0	10	26	284.5	10	23	375.6	10	26	604.9	10	23
1991	118.4	8	31	135.0	8	31	140.4	9	1	150.2	9	2	150.2	9	2	158.7	9	24	270.2	10	5	492.3	10	11
1992	181.3	6	21	207.1	6	21	215.1	6	21	222.9	6	21	256.6	6	21	281.6	6	22	394.7	6	30	568.6	7	14
1993	59.0	5	26	66.0	5	5	86.4	9	28	106.5	9	28	124.4	9	28	151.9	6	1	230.3	10	6	404.0	10	3
1994	103.5	9	14	117.5	9	15	119.2	9	16	142.7	8	15	185.8	9	18	215.5	9	19	381.0	9	19	491.8	10	7
1995	98.8	8	2	136.2	8	24	164.6	8	25	166.4	8	25	170.0	8	25	253.3	8	29	324.4	8	29	513.5	9	18

Table.B.8 BASIN-AVERAGED MAXIMUM RAINFALL (mm) BY DURATION
 Thiessen Corf. Santiago de Maria=0.191, San Francisco Gotera=0.300, El Papalon=0.509

Year	1day	2day	3day	4day	5day	7day	14day	30day	Month Day	Month Day	Month Day	Month Day	Month Day
1964	64.3	71.7	89.9	103.2	114.0	136.7	199.6	359.6	7	9	2	7	31
1965	67.0	80.0	111.0	117.8	130.2	174.0	290.6	505.8	6	10	23	9	27
1966	52.2	75.4	106.4	127.1	152.8	205.4	245.5	479.3	7	11	13	6	26
1967	N/A												
1968	N/A												
1969	N/A												
1970	52.9	76.6	89.2	127.8	134.5	150.0	247.0	452.2	4	15	16	6	23
1971	55.7	70.5	99.0	119.1	130.6	134.8	229.1	408.7	5	19	12	9	11
1972	45.1	68.5	87.3	98.0	116.4	152.1	267.1	394.4	6	6	9	10	6
1973	66.7	97.9	125.8	150.4	165.4	213.3	320.6	562.3	5	22	31	8	17
1974	184.8	205.1	259.0	263.3	267.4	271.8	383.3	528.7	9	20	21	9	20
1975	50.8	74.2	97.8	128.8	133.7	168.5	255.2	498.4	9	5	9	12	4
1976	112.9	150.9	181.6	186.8	188.3	202.6	330.4	516.8	6	13	13	5	30
1977	61.4	99.7	105.7	127.0	156.1	209.5	299.2	406.1	5	31	6	6	27
1978	125.1	132.0	170.5	173.3	187.6	207.2	300.0	472.5	9	21	9	30	28
1979	58.8	86.4	121.3	128.4	152.5	184.1	314.6	558.5	6	4	4	9	13
1980	81.7	100.1	117.3	149.4	160.2	184.7	318.7	506.5	6	13	15	6	25
1981	103.6	118.0	158.2	172.5	173.2	221.4	241.0	394.0	5	5	7	5	3
1982	150.4	191.9	228.8	232.9	257.2	285.3	370.4	535.4	9	20	20	9	23
1983	47.3	68.9	83.5	104.4	113.7	130.2	204.3	373.1	8	31	1	9	10
1984	59.3	84.1	84.3	107.5	118.9	147.9	237.4	360.6	7	24	24	7	8
1985	162.4	201.9	215.9	227.8	236.1	242.6	263.5	391.1	11	3	11	5	2
1986	57.0	82.4	88.9	110.4	120.1	140.6	231.3	367.7	9	28	3	6	1
1987	111.7	138.3	139.0	169.2	195.8	206.8	315.9	442.6	8	4	8	8	9
1988	170.1	230.6	250.3	288.7	273.1	326.8	414.1	722.1	9	16	9	8	19
1989	100.3	143.4	173.1	234.6	235.3	241.2	335.5	627.4	6	6	7	9	29
1990	73.2	115.1	117.4	126.6	133.3	175.9	240.7	444.1	11	6	10	23	3
1991	82.7	100.3	107.7	129.9	142.0	200.5	294.2	405.6	8	28	6	28	10
1992	78.4	99.9	192.7	234.3	281.3	299.8	422.4	612.4	9	29	9	30	12
1993	107.0	112.9	118.8	129.5	135.3	187.4	249.9	435.3	4	27	5	6	10
1994	67.8	83.0	109.2	125.2	136.3	146.4	251.8	422.5	9	27	9	27	1
1995	71.7	90.6	103.1	111.2	126.1	178.7	268.7	503.1	10	19	17	8	7

Table. B.9

PROBABLE RAINFALL BY RETURN PERIOD

Station	Code	Duration	Return Period in year							Unit:m
			2	5	10	20	50	100	200	
San Francisco Gotera	Z02	6hour	64.8	86.4	100.8	115.2	129.6	144.0	154.8	
		1day	96.8	124.3	141.7	157.7	178.2	193.6	208.6	
		7day	221.3	277.5	312.4	344.3	384.5	414.6	443.5	
		14day	323.6	382.5	417.6	448.6	486.8	514.7	541.0	
		30day	549.5	663.7	732.6	794.3	871.0	927.5	981.1	
El Papalon	M06	6hour	54.0	86.4	108.0	133.2	165.6	190.8	219.6	
		1day	98.0	152.0	191.3	231.0	286.2	331.4	377.7	
		7day	206.1	263.3	299.3	332.4	374.6	406.5	437.2	
		14day	291.1	367.7	415.6	459.5	515.0	556.7	596.8	
		30day	453.9	557.5	620.8	678.0	749.5	802.6	853.2	
Santiago de Maria	U06	6hour	61.2	97.2	122.4	147.6	180.0	208.8	241.2	
		1day	99.3	136.8	161.8	185.6	217.1	241.5	265.7	
		7day	237.1	320.8	375.7	427.7	495.6	548.1	599.7	
		14day	338.1	429.7	487.2	539.9	607.0	657.5	706.1	
		30day	538.3	653.3	723.0	785.5	863.4	921.0	975.6	
Basin average		1day	80.4	117.3	143.1	168.3	202.4	229.7	257.0	
		7day	191.4	240.9	271.7	299.9	335.5	362.2	387.9	
		14day	282.5	338.8	372.7	402.9	440.2	467.7	493.7	
		30day	464.5	548.8	598.8	643.1	697.6	737.5	775.0	
Sesori	M18	6hour	43.2	64.8	79.2	90.0	108.0	122.4	133.2	
Hacienda San Hose	M14	6hour	64.8	93.6	111.6	133.2	158.4	180.0	201.6	
La Carrea	U11	6hour	86.4	104.4	115.2	126.0	144.0	151.2	162.0	

Table.B.10 ANNUAL MAXIMUM DISCHARGE AND WATERLEVEL AT VILLERIAS (1/5)
 Period:May 1970-December 1978

Year	Month	Day	Waterlevel (m)	Discharge(m3/s)	Remark
1970	9	4	5.66	866.00	
1971	9	2	5.12	734.00	
1972				*	No data
1973	10	8	4.01	490.00	
1974	9	20	5.44	685.00	
1975	9	24	6.83	1079.12	
1976	6	5	N/A	N/A	Data incomplete
1977	6	15	5.04	578.91	
1978	9	21	4.58	462.09	

Table.B.10 ANNUAL MAXIMUM DISCHARGE AND WATERLEVEL AT MOSCOSO (2/5)
 Period:January 1964-December 1981

Year	Month	Day	Waterlevel (m)	Discharge(m3/s)	Remark
1963					* Data incomplete
1964					* Data inco
1965	9	8	3.72	494.70	
1966	6	22	6.36	917.10	
1967	10	5	5.15	719.50	
1968	9	24	4.02	538.70	
1969	9	4	8.30	2784.88	revised to 1982m3/s
1970	9	4	5.64	880.00	
1971	9	3	5.48	841.50	
1972	10	8	4.08	777.39	
1973	9	16	8.48	921.00	
1974	9	8	3.26	218.32	
1975	9	24	6.90	709.84	
1976	6	5	7.27	760.87	
1977	6	16	4.96	405.09	
1978	9	21	5.34	382.11	
1979	8	31	6.19	395.33	
1980					* Data incomplete

**Table.B.10 ANNUAL MAXIMUM DISCHARGES AND WATERLEVEL (3/5)
AT EL DELIRIO (LA CANOA)
Period:January 1963-April 1981**

Year	Month	Day	Waterlevel (m)	Discharge(m3/s)	Remark
1963	11	9	4.52	631.60	
1964	9	2	3.52	280.60	
1965					* Data incomplete
1966	6	22	4.58	187.00	
1967					* Data incomplete
1968-1976					* No data
1977	6	16	4.76	109.34	
1978	8	28	5.49	115.00	
1979	10	9	5.52	189.41	
1980					* Data incomplete

Remark: Until 1967 measured at El Delirio and after 1977 measured at La Canoa

**Table.B.10 ANNUAL MAXIMUM DISCHARGE AND WATERLEVEL AT VADO MARIN (4/5)
Period:May 1959-March 1981**

Year	Month	Day	Waterlevel (m)	Discharge(m3/s)	Remark
1959	10	20	2.16	57.9	
1960					Data incomplete
1961	10	9	2.44	188.8	
1962	9	27	2.59	156.0	
1963	11	11	3.22	248.1	
1964	9	4	2.56	134.4	
1965	10	1	2.74	218.9	
1966	7	15	2.84	289.8	
1967	10	14	2.1	96.0	
1968	9	26	2.4	155.0	
1969	9	6	3.84	296.0	
1970	10	5	3.13	230.9	
1971	9	5	2.42	131.5	
1972	10	10	2.03	82.0	
1973	10	26	3.65	237.5	
1974	9	22	4.22	307.9	
1975	9	13	2.72	135.8	
1976	6	14	3.9	286.7	
1977	10	1	1.83	48.0	
1978	9	22	2.62	133.6	
1979	9	15	2.68	143.7	
1980	6	25	3.14	215.2	

Table.B.10 ANNUAL MAXIMUM DISCHARGE AND WATERLEVEL AT LAS CONCHAS (5/5)

Period:May 1970-April 1981

Year	Month	Day	Waterlevel(m)	Discharge(m3/s)
1970	8	4	2.80	274.00
1971	10	21	2.00	148.00
1972	10	20	2.69	203.00
1973	10	24	4.10	287.00
1974	5	23	2.04	90.00
1975				* Data incomplete
1976	10	10	2.72	111.33
1977	6	8	3.18	136.51
1978	9	20	3.75	389.56
1979	6	14	4.22	659.28 revised to 222.4m2/s
1980	6	23	4.90	1471.22 revised to 302.4m3/s

Table.B.11 ANNUAL MINIMUM DISCHARGE AT VILLERIAS (1/5)

Year	Month	Day	Discharge(m3/s)	Remark
1970				Data incomplete
1971	4	12	1.340	
1972	4	6	0.900	
1973	3	14	1.360	
1974	3	29	1.440	
1975	3	25	0.730	
1976	5	13	0.610	
1977	4	30	0.997	
1978	4	20	1.030	

Table.B.11 ANNUAL MINIMUM DISCHARGE AT MOSCOSO (2/5)

Year	Month	Day	Discharge(m3/s)	Remark
1963				Data incomplete
1964	4	19	1.500	
1965	3	10	4.000	
1966	3	17	2.000	
1967	3	18	6.250	
1968	3	28	2.500	
1969	4	2	2.390	
1970	4	23	1.750	
1971	4	12	1.680	
1972	4	6	1.120	
1973	2	21	1.380	
1974	3	5	1.990	
1975	3	25	0.910	
1976	4	9	1.700	
1977	12	31	1.880	
1978	4	11	1.280	
1979	3	18	1.270	
1980	4	26	2.130	

**Table.B.11 ANNUAL MINIMUM DISCHARGES (3/5)
AT EL DELIRIO (LA CANOA)**

Year	Month	Day	Discharge(m3/s)	Remark
1963	1	31	2.000	
1964	3	20	4.300	
1965	3	23	1.800	
1966	11	28	0.420	
1967	6	1	0.590	
1968-1976				No data
1977	12	31	2.600	
1978	4	8	1.350	
1979	4	19	1.280	
1980	5	3	0.160	

Table.B.11 ANNUAL MINIMUM DISCHARGE AT VADO MARIN (4/5)

Year	Month	Day	Discharge(m3/s)	Remark
1959				Data incomplete
1960				Data incomplete
1961	2	27	7.320	
1962	1	31	7.100	
1963	4	26	6.300	
1964	4	1	6.070	
1965	4	14	4.050	
1966	3	22	4.100	
1967	3	15	3.700	
1968	4	6	2.960	
1969	4	16	3.400	
1970	4	26	3.850	
1971	5	9	4.280	
1972	4	7	3.830	
1973	5	12	4.280	
1974	4	29	3.290	
1975	4	30	2.520	
1976	4	10	2.710	
1977	4	15	3.097	
1978	5	6	2.420	
1979	3	14	2.160	
1980	1	31	4.470	

Table.B.11 ANNUAL MINIMUM DISCHARGE AT LAS CONCHAS (5/5)

Year	Month	Day	Discharge(m ³ /s)	Remark
1970	5	1	9.460	
1971	4	24	7.690	
1972	4	6	6.280	
1973	3	9	6.900	
1974	3	9	6.740	
1975	5	1	5.160	
1976	4	10	6.050	
1977	3	12	5.673	
1978	4	12	4.600	
1979	3	17	4.740	
1980	5	4	5.183	

Table.B.12

MAXIMUM MONTHLY AVERAGED DISCHARGE BY YEAR

Unit: m³/s

Year	Villeras	Month	Rank	Moscoso	Month	Rank	Vado Marin	Month	Rank
1959	No data			No data			44.7	10	20
1960	No data			No data			No data		
1961	No data			No data			133.1	10	3
1962	No data			No data			103.6	10	7
1963	No data			No data			98.2	9	9
1964	No data			No data			93.7	9	12
1965	No data			71.8	9	6	94.4	9	11
1966	No data			62.0	6	10	111.9	7	6
1967	No data			44.2	10	14	50.3	10	19
1968	No data			45.8	9	13	73.5	10	17
1969	No data			181.0	9	1	159.0	9	1
1970	65.9	9	5	86.0	9	5	132.0	10	4
1971	58.3	10	6	71.1	10	7	87.1	9	15
1972	30.1	10	8	41.6	10	15	56.7	10	18
1973	88.1	10	1	110.0	10	3	140.0	10	2
1974	46.1	9	7	55.9	9	12	87.7	9	14
1975	69.8	9	3	88.1	9	4	92.9	9	13
1976	76.3	6	2	111.2	6	2	96.3	6	10
1977	22.2	6	9	30.0	6	16	28.7	6	21
1978	69.7	9	4	69.0	9	8	84.5	9	16
1979	No data			58.5	9	11	103.5	9	8
1980	No data			63.3	10	9	119.2	10	5

Table.B.13

MAXIMUM MONTHLY RAINFALL BY YEAR

Unit: mm

Year	Usulután	Rank	Olomega	Rank	San Miguel	Rank	San F. G.	Rank
1959	386	24	448	13	266	28	431	23
1960	499	13	495	10	461	9	498	14
1961	394	22	580	3	545	5	393	29
1962	388	23	488	11	430	12	540	8
1963	522	10	469	12	539	6	441	21
1964	519	11	446	14	316	25	448	19
1965	585	5	556	5	561	3	436	22
1966	406	20	335	22	366	16	502	13
1967	364	28	312	26	335	19	448	19
1968	414	19	439	16	333	21	491	16
1969	509	12	535	7	688	1	485	17
1970	482	15	355	20	422	13	505	12
1971	398	21	375	19	326	22	608	2
1972	319	29	436	17	251	30	303	32
1973	498	14	317	23	318	24	591	4
1974	555	6	631	2	320	23	419	24
1975	721	2	355	20	431	11	492	15
1976	385	25	528	8	505	7	598	3
1977	909	1	250	30	248	31	393	29
1978	550	7	265	29	264	29	547	7
1979	459	17	434	18	464	8	398	27
1980	433	18	442	15	335	19	550	6
1981	370	26	522	9	439	10	396	28
1982	539	8	313	25	378	15	530	9
1983	248	31	278	27	305	26	513	10
1984	461	16	550	6	344	17	399	26
1985	267	30	241	31	305	26	483	18
1986	365	27	267	28	344	17	349	31
1987	523	9	314	24	405	14	405	25
1988	686	3	561	4	561	3	620	1
1989	623	4	655	1	655	2	557	5
1990	No data		No data		No data		513	10

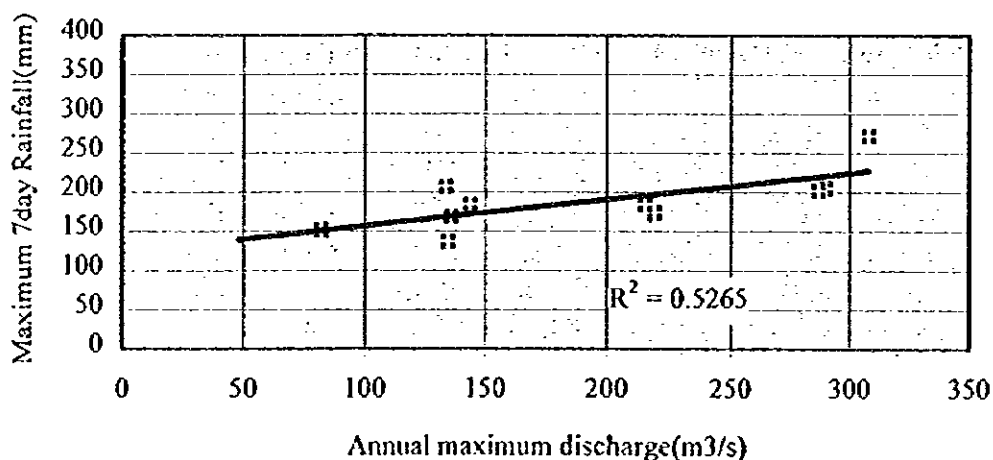
Note: 1988 of San Miguel and Olomega are used of Beneficio El Sitio

Table.B.14 ANNUAL MAXIMUM DISCHARGES AT VADO MARIN AND 7 DAYS RAINFALL.

Period:May 1959-March 1981

Year	Month	Day	Waterlevel(m)	Discharge(m ³ /s)	Ranking	Maximum Basin averaged 7days Rainfall in mm	Month	Day
1959	10	20	2.16	57.9	20			
1960	Data incomplete							
1961	10	9	2.44	188.8	10			
1962	9	27	2.59	156.0	11			
1963	11	11	3.22	248.1	5			
1964	9	4	2.56	134.4	15	136.7	9	2
1965	10	1	2.74	218.9	8	174.0	9	23
1966	7	15	2.84	289.8	3	205.4	7	14
1967	10	14	2.1	96.0	18			
1968	9	26	2.4	155.0	12			
1969	9	6	3.84	296.0	2			
1970	10	5	3.13	230.9	7			
1971	9	5	2.42	131.5	17			
1972	10	10	2.03	82.0	19	152.1	9	29
1973	10	26	3.65	237.5	6			
1974	9	22	4.22	307.9	1	271.8	9	23
1975	9	13	2.72	135.8	14	168.5	9	12
1976	6	14	3.9	286.7	4	202.6	6	13
1977	10	1	1.83	48.0	21			
1978	9	22	2.62	133.6	16	207.2	9	25
1979	9	15	2.68	143.7	13	184.1	9	4
1980	6	25	3.14	215.2	9	184.7	6	15

Relation between annual maximum discharge and the corresponding 7 days rainfall(only the event of annual maximum)



**Table.B.15 LOW WATER SPRINGS AT EL TRIUNFO PORT
BETWEEN 1994-1996**

Year	Month	Day	Time	Low water spring tide(MSL)	Average
1994	1	1	11	-1.42	
1994	1	13	9	-1.40	
1994	1	30	10	-1.55	
1994	2	12	10	-1.32	
1994	2	28	22	-1.66	
1994	3	14	22	-1.27	
1994	3	29	22	-1.74	
1994	4	12	22	-1.25	
1994	4	27	22	-1.71	
1994	5	12	22	-1.19	
1994	5	26	21	-1.61	
1994	6	12	23	-1.22	
1994	6	24	21	-1.47	
1994	7	12	23	-1.30	
1994	7	24	22	-1.37	
1994	8	10	23	-1.42	
1994	8	22	21	-1.27	
1994	9	9	11	-1.53	
1994	9	21	9	-1.25	
1994	10	7	10	-1.66	
1994	10	21	9	-1.22	
1994	11	5	9	-1.69	
1994	11	20	10	-1.19	
1994	12	4	8	-1.66	
1994	12	21	10	-1.22	-1.42
1995	1	3	10	-1.61	
1995	1	20	11	-1.35	
1995	2	1	9	-1.53	
1995	2	19	11	-1.47	
1995	3	3	10	-1.45	
1995	3	19	22	-1.59	
1995	4	1	22	-1.35	
1995	4	17	22	-1.66	
1995	5	1	22	-1.25	
1995	5	15	22	-1.66	
1995	5	31	22	-1.17	
1995	6	15	22	-1.64	
1995	6	30	22	-1.14	
1995	7	13	21	-1.55	
1995	7	31	23	-1.22	
1995	8	12	22	-1.50	
1995	8	29	23	-1.32	
1995	9	11	10	-1.42	
1995	9	27	10	-1.47	
1995	10	10	9	-1.37	
1995	10	26	10	-1.59	
1995	11	8	9	-1.27	
1995	11	25	10	-1.66	
1995	12	9	10	-1.22	
1995	12	24	10	-1.69	-1.45
1996	1	8	10	-1.22	
1996	1	22	10	-1.71	
1996	2	7	10	-1.27	
1996	2	20	9	-1.66	
1996	3	8	23	-1.37	
1996	3	20	21	-1.55	
1996	4	6	22	-1.47	
1996	4	18	21	-1.42	
1996	5	5	22	-1.55	
1996	5	18	21	-1.30	
1996	6	3	22	-1.59	
1996	6	17	22	-1.17	
1996	7	3	22	-1.61	
1996	7	17	22	-1.12	
1996	8	1	22	-1.64	
1996	8	15	22	-1.14	
1996	8	30	22	-1.61	
1996	9	15	10	-1.25	
1996	9	29	10	-1.59	
1996	10	15	10	-1.37	
1996	10	28	9	-1.50	
1996	11	14	10	-1.50	
1996	11	26	9	-1.37	
1996	12	13	10	-1.59	
1996	12	25	9	-1.27	-1.43

-1.43 Mean Low Water Spring(MSL)

**Table.B.16 HIGH WATER SPRINGS AT EL TRIUNFO PORT
BETWEEN 1994-1996**

Year	Month	Day	Time	High water spring Gde(MSL)	Average
1994	1	2	18	1.29	
1994	1	12	3	1.30	
1994	1	31	18	1.47	
1994	2	12	16	1.22	
1994	2	28	17	1.58	
1994	3	13	16	1.19	
1994	3	29	16	1.65	
1994	4	12	16	1.19	
1994	4	27	16	1.65	
1994	5	12	16	1.19	
1994	5	26	15	1.63	
1994	6	10	15	1.22	
1994	6	24	15	1.53	
1994	7	11	15	1.30	
1994	7	23	15	1.42	
1994	8	11	5	1.42	
1994	8	21	15	1.50	
1994	9	9	5	1.55	
1994	9	21	3	1.25	
1994	10	7	4	1.63	
1994	10	20	3	1.19	
1994	11	5	3	1.65	
1994	11	20	4	1.17	
1994	11	29	23	1.17	
1994	12	4	3	1.60	
1994	12	20	4	1.17	
1994	12	31	1	1.35	1.38
1995	1	3	4	1.53	
1995	1	21	18	1.25	
1995	2	2	17	1.40	
1995	2	19	18	1.49	
1995	3	3	16	1.35	
1995	3	20	17	1.50	
1995	3	31	15	1.27	
1995	4	17	16	1.58	
1995	4	30	15	1.22	
1995	5	16	16	1.63	
1995	5	30	15	1.19	
1995	6	14	15	1.63	
1995	6	29	16	1.19	
1995	7	13	15	1.60	
1995	7	29	16	1.22	
1995	8	11	15	1.50	
1995	8	30	5	1.35	
1995	9	11	4	1.42	
1995	9	27	4	1.45	
1995	10	9	3	1.35	
1995	10	27	4	1.55	
1995	11	7	2	1.25	
1995	11	24	3	1.58	
1995	12	8	3	1.17	
1995	12	24	4	1.58	1.41
1996	1	8	4	1.14	
1996	1	22	4	1.55	
1996	2	8	17	1.19	
1996	2	20	16	1.53	
1996	3	8	17	1.30	
1996	3	20	16	1.47	
1996	4	6	16	1.40	
1996	4	18	15	1.40	
1996	5	5	15	1.50	
1996	5	17	15	1.30	
1996	6	3	15	1.58	
1996	6	16	15	1.22	
1996	7	3	16	1.63	
1996	7	17	16	1.19	
1996	8	1	16	1.63	
1996	8	16	16	1.19	
1996	8	31	4	1.60	
1996	9	16	5	1.27	
1996	9	29	4	1.55	
1996	10	15	4	1.35	
1996	10	28	3	1.47	
1996	11	13	4	1.42	
1996	11	26	3	1.35	
1996	12	13	4	1.50	
1996	12	25	3	1.19	1.40

1.39 Mean High Water Spring(MSL)

Table.B.17 MAXIMUM WATERLEVEL IN LAKE OMEGA

Number	Year	Month	Day	Waterlevel (MSL+)
1	1970	10	4	66.37
2	1971	10	26	65.90
3	1972	10	21	65.68
4	1973	10	12	66.42
5	1974	10	4	66.15
6	1975	10	3	65.84
7	1976	6	14	65.78
8	1977	10	2	64.34
9	1978	10	7	65.39
10	1979	9	5	66.18
11	1980	10	8	66.25
12	1981	10	15	66.07
13	1996	10	19	66.06
Average				65.88

Thomas plot of waterlevel of Lake Olomega

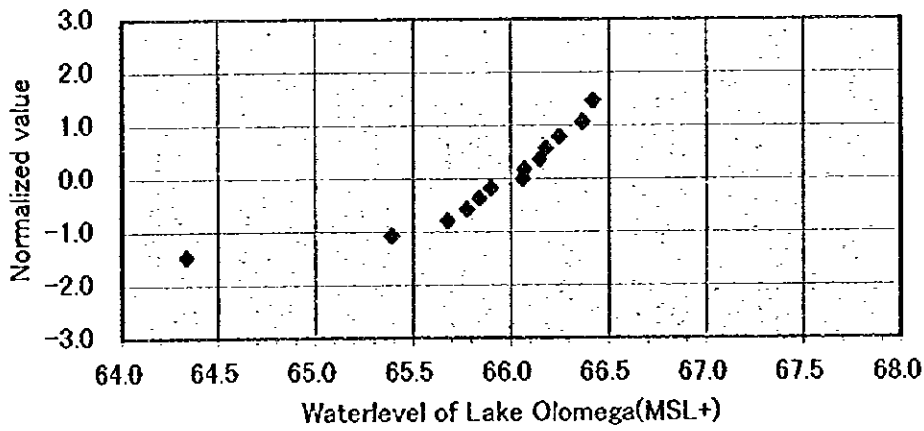


Table.B.18 AVAILABLE RAINFALL RECORDS FOR CALIBRATION

July-September, 1995		
Kind of rainfall data	Station name	Number
Hourly rainfall data	Z2:San Francisco Gotera	3
	M6:El Papalon	
Daily rainfall data	U6:Santiago de Maria	13
	Z5:Corinto	
	Z8:Osicala	
	M16:Chapeltique,	
	M18:Sesori	
	M5:Ciudad Barrios	
	N11:Yucuaiquin	
	M15:Beneficio El Sitio	
	M2:San Miguel Fenadesal	
	M7:San Jorge	
	M4:Lolotique	
	U14:Puerto Parada	
U13:Jucuaran		
N16:San Alejo		
June 1980 flood		
Kind of rainfall data	Station name	Number
Hourly rainfall data	Z2:San Francisco Gotera	4
	M6:El Papalon	
	M18:Sesori	
	U13:Jucuaran	
Daily rainfall data	N11:Yucuaiquin	10
	M15:Beneficio El Sitio	
	N16:San Alejo	
	Uluazapa	
	M5:Ciudad Barrios	
	M4:Lolotique	
	M17:Hacienda El Canal	
	M12:Canton La Lava	
	U4:Usulután	
U14:Puerto Parada		
September 1975		
Kind of rainfall data	Station name	Number
Hourly rainfall data	U6:Santiago de Maria	7
	Z2:San Francisco Gotera	
	El Papalon	
	Z5:Corinto	
	U13:Jucuaran	
	M14:Hacienda San Jose	
Daily rainfall data	M18:Sesori	15
	U4:Usulután	
	U8:BeneficioMauricio Z6:Jocoro	
	Z8:Osicala	
	M15:Beneficio El Sitio	
	M2:San Miguel	
	N11:Yucuaiquin	
	N1:Olomega	
	U16:San Alejo	
	M17:HaciendaEl Canal	
	U14:Puerto Parada	
	M12:Canton la Lava	
	M16:Chapeltique	
M4:Lolotique		
M5:Ciudad Barrios		

Table B.19 Basin and channel constants for Storage function for the Design (1/2)

Basin Constants									
Basin No.	Area (km ²)	KO	a	K=akO	P	Tl (hour)	F1	Res (mm)	Base flow (m ³ /s)
1	112.6	78.7	0.15	11.8	0.6	0.82	0.31	2000	5.07
2	153.6	79.6	0.15	11.9	0.6	0.64	0.31	2000	4.24
3	128.5	74.9	0.15	11.2	0.6	0.73	0.31	2000	1.91
4	57.8	82.3	0.15	12.3	0.6	0.30	0.31	2000	4.00
5	121.2	70.7	0.15	10.6	0.6	0.73	0.31	2000	7.49
6	227.1	84.6	0.15	12.7	0.6	0.85	0.31	2000	0.80
7	24.2	32.7	0.15	4.9	0.6	0.00	0.31	2000	2.80
8	85.0	57.4	0.15	8.6	0.6	0.40	0.31	2000	1.78
9	54.0	34.1	0.23	7.8	0.6	0.15	0.28	2000	3.21
10	97.2	103.5	0.23	23.8	0.6	0.70	0.28	2000	0.42
11	12.8	38.6	0.23	8.9	0.6	0.00	0.28	2000	4.51
12	136.8	49.2	0.23	11.3	0.6	0.42	0.28	2000	6.82
13	207.0	122.2	0.23	28.1	0.6	0.68	0.28	2000	7.23
14	219.2	100.0	0.23	23.0	0.6	1.35	0.28	2000	8.67
15	263.0	110.3	0.23	25.4	0.6	1.24	0.22	2000	4.54
16	137.7	63.1	0.20	12.6	0.6	0.67	0.22	2000	6.59
17	198.9	66.1	0.20	13.2	0.6	0.75	0.22	2000	0.30
18	9.2	41.1	0.20	8.2	0.6	0.00	0.22	2000	0.10

Channel Constant			
Channel No	K	P	Tl (hr)
19-20			0.60
21-22			4.18
24-25			0.56
27-28			0.45
29-30	25000	0.65	0.13
32-33	15848	0.65	0.08
34-35	63095	0.65	0.35
36-37	79432	0.65	0.26
40-41	79432	0.65	0.30
42-43	79432	0.65	0.40
44-45	125892	0.65	0.61
46-47	50118	0.65	0.24

Table B.19 Basin and channel constants for Storage function for existing condition (1995) (2/2)

Basin Constants									
Basin No.	Area (km ²)	KO	a	K=akO	P	Tl (hour)	F1	Res (mm)	Base flow (m ³ /s)
1	112.6	78.9	0.15	11.8	0.6	0.82	0.35	2000	1.24
2	153.6	79.6	0.15	11.9	0.6	0.64	0.35	2000	1.69
3	128.5	74.9	0.15	11.2	0.6	0.73	0.35	2000	1.41
4	57.8	82.3	0.15	12.3	0.6	0.30	0.35	2000	0.64
5	121.2	70.8	0.15	10.6	0.6	0.73	0.35	2000	1.33
6	227.1	84.8	0.15	12.7	0.6	0.85	0.35	2000	2.50
7	24.2	32.7	0.15	4.9	0.6	0.00	0.35	2000	0.27
8	85.0	57.7	0.15	8.6	0.6	0.40	0.35	2000	0.93
9	54.0	33.1	0.23	7.6	0.6	0.15	0.28	2000	0.59
10	97.2	103.4	0.23	23.8	0.6	0.70	0.28	2000	1.07
11	12.8	42.6	0.23	9.8	0.6	0.00	0.28	2000	0.14
12	136.8	50.0	0.23	11.5	0.6	0.42	0.28	2000	1.50
13	207.0	122.2	0.23	28.1	0.6	0.68	0.28	2000	2.27
14	219.2	100.1	0.23	23.0	0.6	1.35	0.28	2000	2.41
15	263.0	110.2	0.23	25.3	0.6	1.24	0.22	2000	2.89
16	137.7	63.3	0.20	12.7	0.6	0.67	0.22	2000	1.51
17	198.9	66.3	0.20	13.3	0.6	0.75	0.22	2000	2.20
18	9.2	41.1	0.20	8.2	0.6	0.00	0.22	2000	0.10

Channel Constants			
Channel No	K	P	Tl (hour)
19-20			0.60
21-22			4.18
24-25			0.56
27-28			0.45
29-30	25000	0.65	0.13
32-33	15848	0.65	0.08
34-35	63095	0.65	0.35
36-37	79432	0.65	0.26
40-41	79432	0.65	0.30
42-43	79432	0.65	0.40
44-45	125892	0.65	0.61
46-47	50118	0.65	0.24

Table.B.20 RECORDED DAILY RAINFALL DURING SEP.10-16, 1988

Month	Day	S1				S2				S3				S4				Basin averaged(S1, 2.3)
		Z2:San Francisco Gotera	M6:EI Papalon	U6:Santiago de Maria	U14:Puerto Parada	M6:EI Papalon	U6:Santiago de Maria	U14:Puerto Parada	M6:EI Papalon	U6:Santiago de Maria	U14:Puerto Parada	M6:EI Papalon	U6:Santiago de Maria	U14:Puerto Parada	M6:EI Papalon	U6:Santiago de Maria	U14:Puerto Parada	
9	10	23.9	1.2	0.1	0.0	7.6	0.0	0.0	7.6	0.0	0.0	0.0	7.6	0.0	0.0	7.6	0.0	7.8
9	11	23.8	6.0	16.9	44.0	16.7	16.9	44.0	16.7	16.9	44.0	16.7	16.9	44.0	16.7	16.9	44.0	13.4
9	12	73.4	16.6	10.6	5.0	31.2	10.6	5.0	31.2	10.6	5.0	31.2	10.6	5.0	31.2	10.6	5.0	32.5
9	13	66.9	16.2	0.2	0.0	27.6	0.2	0.0	27.6	0.2	0.0	27.6	0.2	0.0	27.6	0.2	0.0	28.4
9	14	30.2	5.1	13.0	11.0	13.8	13.0	11.0	13.8	13.0	11.0	13.8	13.0	11.0	13.8	13.0	11.0	14.1
9	15	47.6	56.6	91.3	68.0	58.3	91.3	68.0	58.3	91.3	68.0	58.3	91.3	68.0	58.3	91.3	68.0	60.5
9	16	122.2	221.6	107.9	62.5	164.0	107.9	62.5	164.0	107.9	62.5	164.0	107.9	62.5	164.0	107.9	62.5	170.1
Total		388.0	323.3	240.0	190.5	319.1	240.0	190.5	319.1	240.0	190.5	319.1	240.0	190.5	319.1	240.0	190.5	326.8

Basin averaged 7 days rainfall for 10 years return period

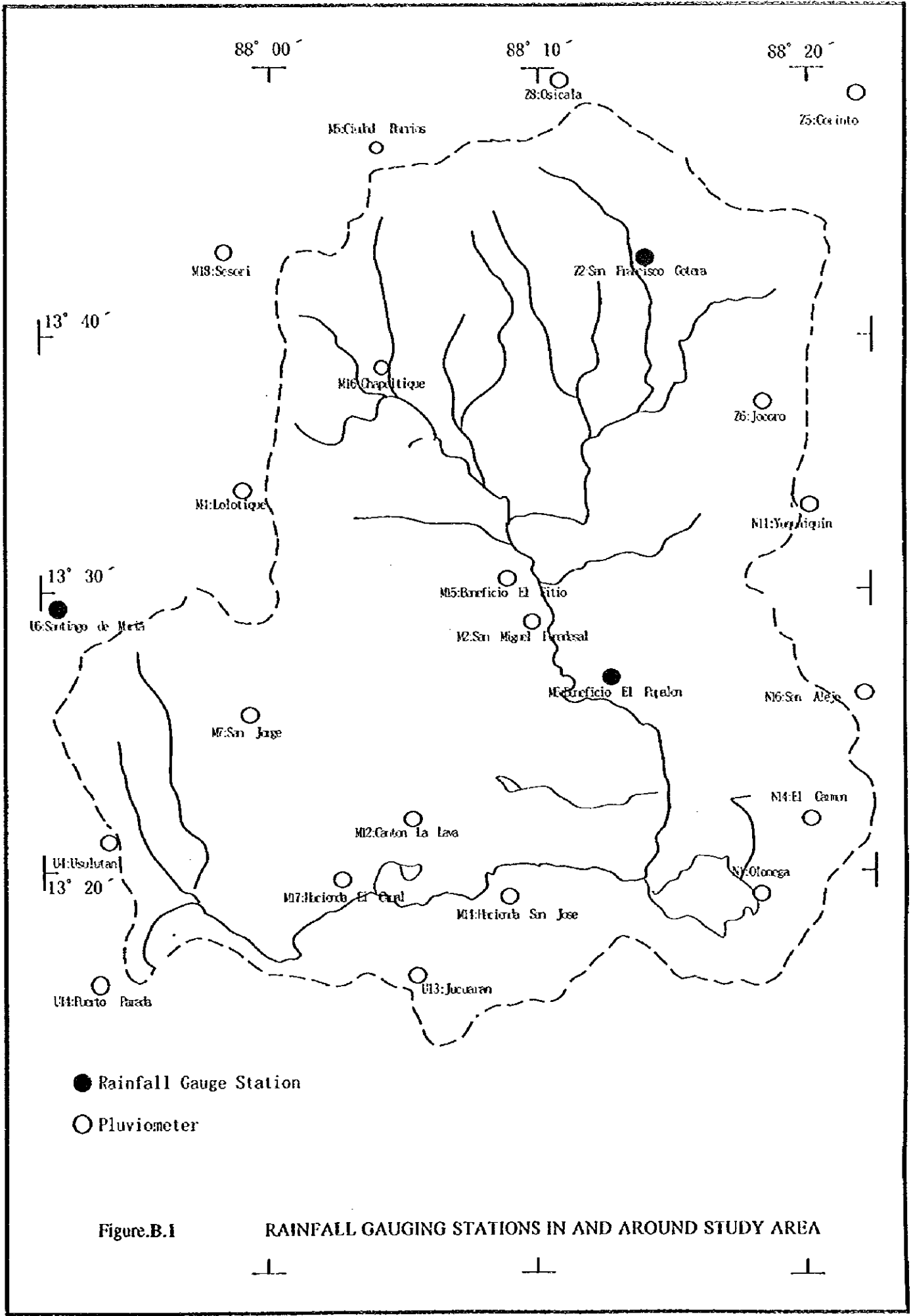
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Rd/Rm= 0.83 (Multiplier)

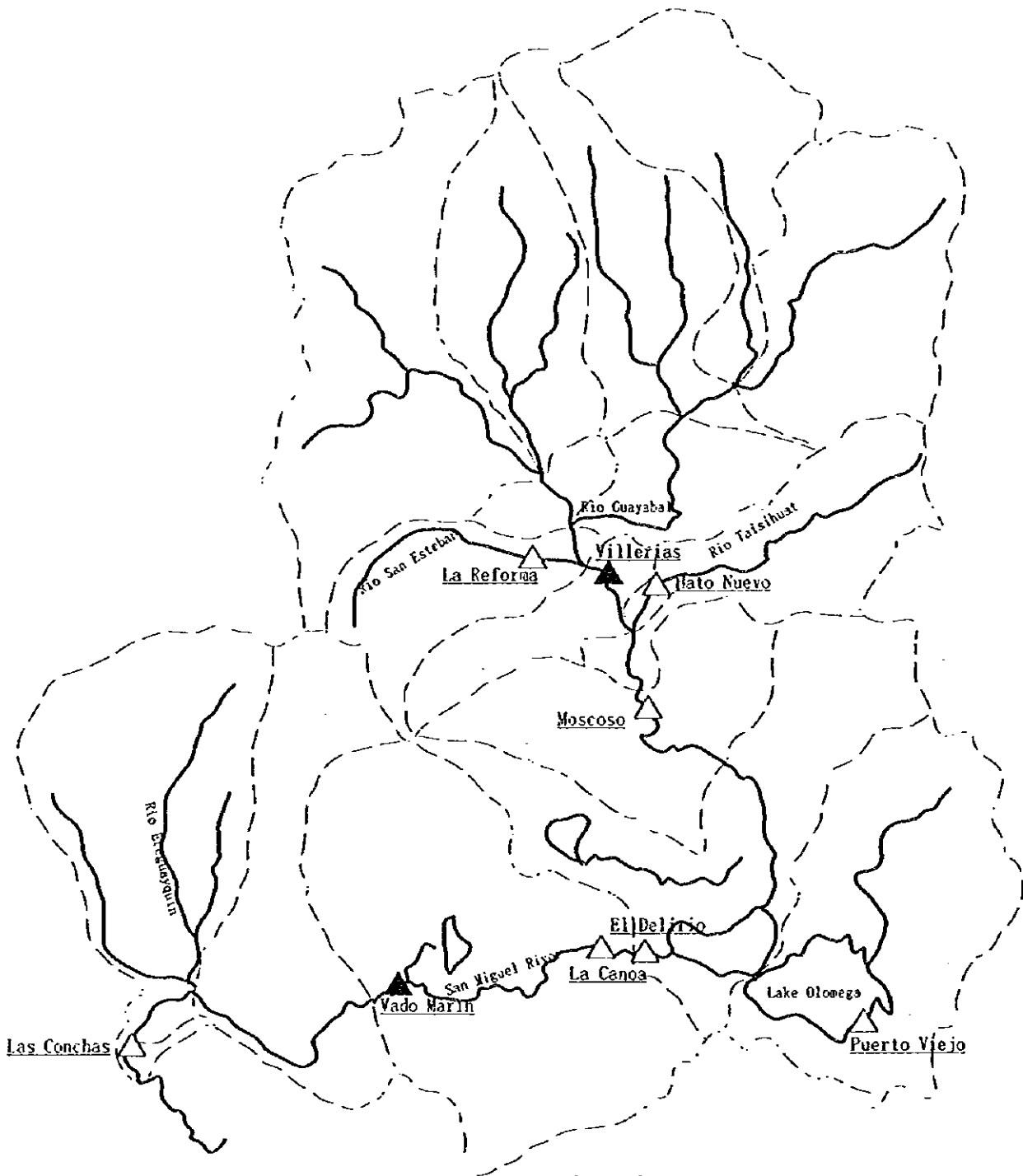
B.T.22

Table.B.21 DECREASED DAILY RAINFALL BY THE MULTIPLIER

Month	Day	S1				S2				S3				S4				Basin averaged(S1, 2.3)
		Z2:San Francisco Gotera	M6:EI Papalon	U6:Santiago de Maria	U14:Puerto Parada	M6:EI Papalon	U6:Santiago de Maria	U14:Puerto Parada	M6:EI Papalon	U6:Santiago de Maria	U14:Puerto Parada	M6:EI Papalon	U6:Santiago de Maria	U14:Puerto Parada	M6:EI Papalon	U6:Santiago de Maria	U14:Puerto Parada	
9	10	19.9	1.0	0.1	0.0	6.3	0.1	0.0	6.3	0.1	0.0	6.3	0.1	0.0	6.3	0.1	0.0	6.5
9	11	19.8	5.0	14.1	36.6	13.8	14.1	36.6	13.8	14.1	36.6	13.8	14.1	36.6	13.8	14.1	36.6	11.2
9	12	61.0	13.8	8.8	4.2	25.9	8.8	4.2	25.9	8.8	4.2	25.9	8.8	4.2	25.9	8.8	4.2	27.0
9	13	55.6	13.5	0.2	0.0	23.0	0.2	0.0	23.0	0.2	0.0	23.0	0.2	0.0	23.0	0.2	0.0	23.6
9	14	25.1	4.2	10.8	9.1	11.5	10.8	9.1	11.5	10.8	9.1	11.5	10.8	9.1	11.5	10.8	9.1	11.8
9	15	39.6	47.1	75.9	56.5	48.5	75.9	56.5	48.5	75.9	56.5	48.5	75.9	56.5	48.5	75.9	56.5	50.3
9	16	101.6	184.2	89.7	52.0	136.3	89.7	52.0	136.3	89.7	52.0	136.3	89.7	52.0	136.3	89.7	52.0	141.4
Total		322.6	268.8	199.5	158.4	265.3	199.5	158.4	265.3	199.5	158.4	265.3	199.5	158.4	265.3	199.5	158.4	271.7







Legend

Waterlevel Gauge

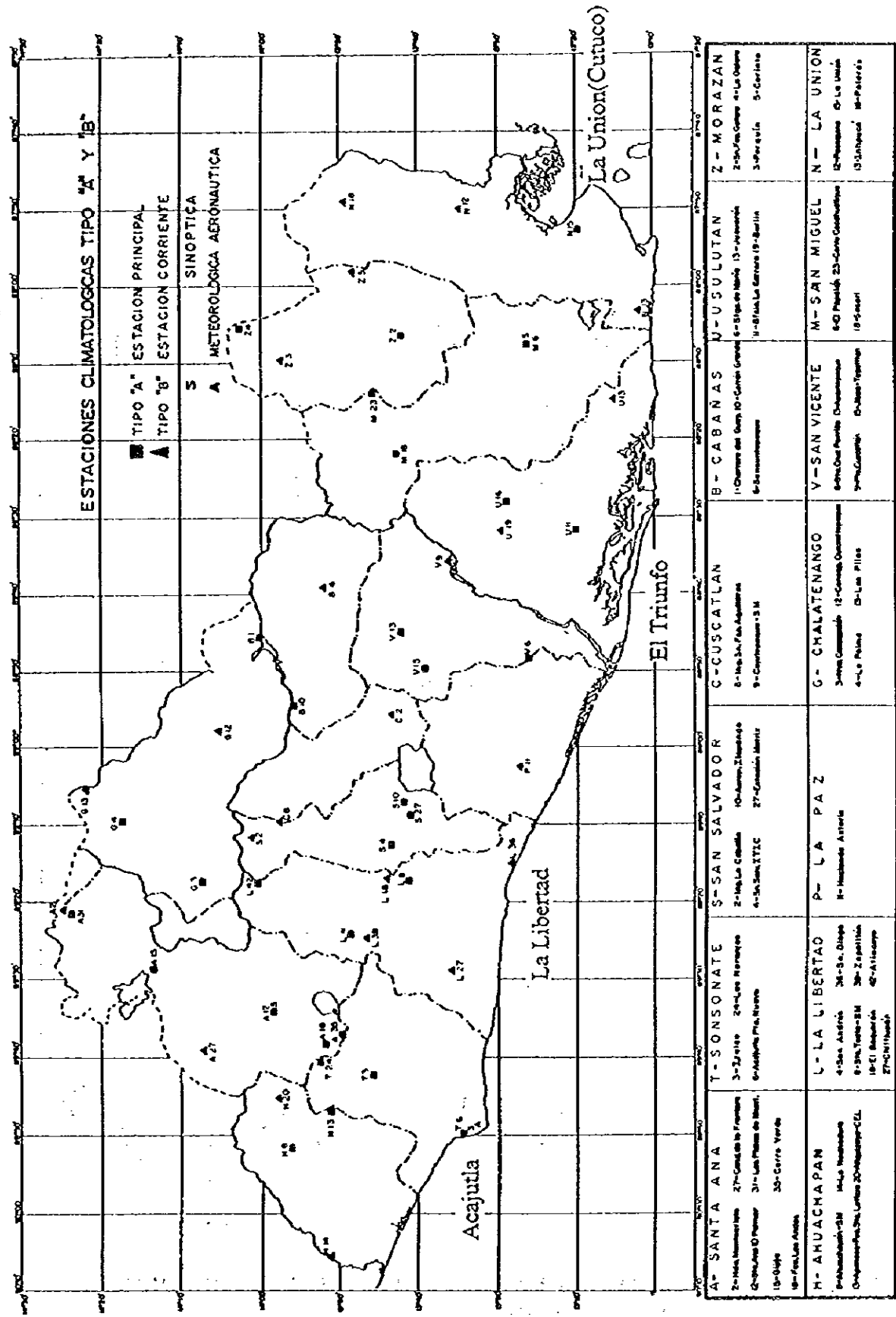
▲ Operating in 1995

△ No Operating in 1995

Figure.B.2

LOCATIONS OF STREAM GAUGING STATIONS

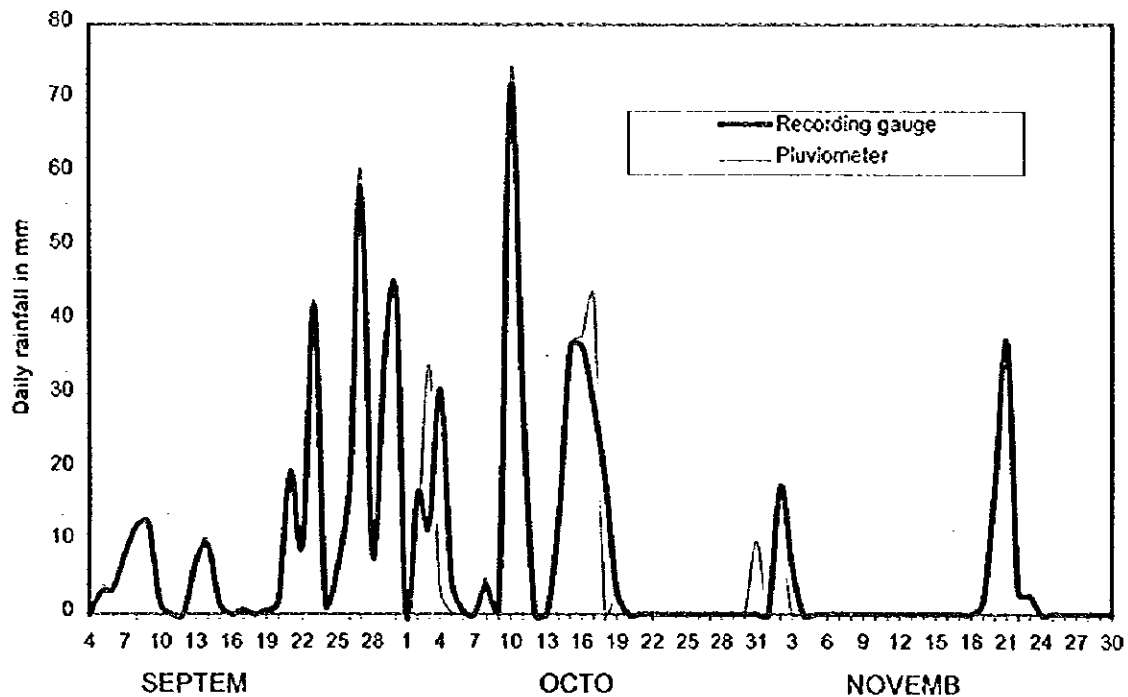
Source: MAG, Almanaque Salvadoreño 1996



ESTACIONES CLIMATOLÓGICAS TIPO "A" Y "B"	TIPO "A" ESTACION PRINCIPAL	TIPO "B" ESTACION CORRIENTE	SINOPTICA	METEOROLOGICA AERONAUTICA									
A - SANTA ANA 2- San Marcos 3- San Marcos 4- San Marcos 5- San Marcos 6- San Marcos 7- San Marcos 8- San Marcos 9- San Marcos 10- San Marcos 11- San Marcos 12- San Marcos 13- San Marcos 14- San Marcos 15- San Marcos 16- San Marcos 17- San Marcos 18- San Marcos 19- San Marcos 20- San Marcos 21- San Marcos 22- San Marcos 23- San Marcos 24- San Marcos 25- San Marcos 26- San Marcos 27- San Marcos 28- San Marcos 29- San Marcos 30- San Marcos	T - SONSONATE 1- San Antonio 2- San Antonio 3- San Antonio 4- San Antonio 5- San Antonio 6- San Antonio 7- San Antonio 8- San Antonio 9- San Antonio 10- San Antonio 11- San Antonio 12- San Antonio 13- San Antonio 14- San Antonio 15- San Antonio 16- San Antonio 17- San Antonio 18- San Antonio 19- San Antonio 20- San Antonio 21- San Antonio 22- San Antonio 23- San Antonio 24- San Antonio 25- San Antonio 26- San Antonio 27- San Antonio 28- San Antonio 29- San Antonio 30- San Antonio	S - SAN SALVADOR 1- San Salvador 2- San Salvador 3- San Salvador 4- San Salvador 5- San Salvador 6- San Salvador 7- San Salvador 8- San Salvador 9- San Salvador 10- San Salvador 11- San Salvador 12- San Salvador 13- San Salvador 14- San Salvador 15- San Salvador 16- San Salvador 17- San Salvador 18- San Salvador 19- San Salvador 20- San Salvador 21- San Salvador 22- San Salvador 23- San Salvador 24- San Salvador 25- San Salvador 26- San Salvador 27- San Salvador 28- San Salvador 29- San Salvador 30- San Salvador	C - CUSCATLAN 1- Cuscatlan 2- Cuscatlan 3- Cuscatlan 4- Cuscatlan 5- Cuscatlan 6- Cuscatlan 7- Cuscatlan 8- Cuscatlan 9- Cuscatlan 10- Cuscatlan 11- Cuscatlan 12- Cuscatlan 13- Cuscatlan 14- Cuscatlan 15- Cuscatlan 16- Cuscatlan 17- Cuscatlan 18- Cuscatlan 19- Cuscatlan 20- Cuscatlan 21- Cuscatlan 22- Cuscatlan 23- Cuscatlan 24- Cuscatlan 25- Cuscatlan 26- Cuscatlan 27- Cuscatlan 28- Cuscatlan 29- Cuscatlan 30- Cuscatlan	B - CABANAS 1- Cabanas 2- Cabanas 3- Cabanas 4- Cabanas 5- Cabanas 6- Cabanas 7- Cabanas 8- Cabanas 9- Cabanas 10- Cabanas 11- Cabanas 12- Cabanas 13- Cabanas 14- Cabanas 15- Cabanas 16- Cabanas 17- Cabanas 18- Cabanas 19- Cabanas 20- Cabanas 21- Cabanas 22- Cabanas 23- Cabanas 24- Cabanas 25- Cabanas 26- Cabanas 27- Cabanas 28- Cabanas 29- Cabanas 30- Cabanas	J - USulután 1- Usulután 2- Usulután 3- Usulután 4- Usulután 5- Usulután 6- Usulután 7- Usulután 8- Usulután 9- Usulután 10- Usulután 11- Usulután 12- Usulután 13- Usulután 14- Usulután 15- Usulután 16- Usulután 17- Usulután 18- Usulután 19- Usulután 20- Usulután 21- Usulután 22- Usulután 23- Usulután 24- Usulután 25- Usulután 26- Usulután 27- Usulután 28- Usulután 29- Usulután 30- Usulután	Z - MORAZAN 1- Morazan 2- Morazan 3- Morazan 4- Morazan 5- Morazan 6- Morazan 7- Morazan 8- Morazan 9- Morazan 10- Morazan 11- Morazan 12- Morazan 13- Morazan 14- Morazan 15- Morazan 16- Morazan 17- Morazan 18- Morazan 19- Morazan 20- Morazan 21- Morazan 22- Morazan 23- Morazan 24- Morazan 25- Morazan 26- Morazan 27- Morazan 28- Morazan 29- Morazan 30- Morazan	N - LA UNION 1- La Unión 2- La Unión 3- La Unión 4- La Unión 5- La Unión 6- La Unión 7- La Unión 8- La Unión 9- La Unión 10- La Unión 11- La Unión 12- La Unión 13- La Unión 14- La Unión 15- La Unión 16- La Unión 17- La Unión 18- La Unión 19- La Unión 20- La Unión 21- La Unión 22- La Unión 23- La Unión 24- La Unión 25- La Unión 26- La Unión 27- La Unión 28- La Unión 29- La Unión 30- La Unión	M - SAN MIGUEL 1- San Miguel 2- San Miguel 3- San Miguel 4- San Miguel 5- San Miguel 6- San Miguel 7- San Miguel 8- San Miguel 9- San Miguel 10- San Miguel 11- San Miguel 12- San Miguel 13- San Miguel 14- San Miguel 15- San Miguel 16- San Miguel 17- San Miguel 18- San Miguel 19- San Miguel 20- San Miguel 21- San Miguel 22- San Miguel 23- San Miguel 24- San Miguel 25- San Miguel 26- San Miguel 27- San Miguel 28- San Miguel 29- San Miguel 30- San Miguel	V - SAN VICENTE 1- San Vicente 2- San Vicente 3- San Vicente 4- San Vicente 5- San Vicente 6- San Vicente 7- San Vicente 8- San Vicente 9- San Vicente 10- San Vicente 11- San Vicente 12- San Vicente 13- San Vicente 14- San Vicente 15- San Vicente 16- San Vicente 17- San Vicente 18- San Vicente 19- San Vicente 20- San Vicente 21- San Vicente 22- San Vicente 23- San Vicente 24- San Vicente 25- San Vicente 26- San Vicente 27- San Vicente 28- San Vicente 29- San Vicente 30- San Vicente	G - CHALATENANGO 1- Chalatenango 2- Chalatenango 3- Chalatenango 4- Chalatenango 5- Chalatenango 6- Chalatenango 7- Chalatenango 8- Chalatenango 9- Chalatenango 10- Chalatenango 11- Chalatenango 12- Chalatenango 13- Chalatenango 14- Chalatenango 15- Chalatenango 16- Chalatenango 17- Chalatenango 18- Chalatenango 19- Chalatenango 20- Chalatenango 21- Chalatenango 22- Chalatenango 23- Chalatenango 24- Chalatenango 25- Chalatenango 26- Chalatenango 27- Chalatenango 28- Chalatenango 29- Chalatenango 30- Chalatenango	P - LA PAZ 1- La Paz 2- La Paz 3- La Paz 4- La Paz 5- La Paz 6- La Paz 7- La Paz 8- La Paz 9- La Paz 10- La Paz 11- La Paz 12- La Paz 13- La Paz 14- La Paz 15- La Paz 16- La Paz 17- La Paz 18- La Paz 19- La Paz 20- La Paz 21- La Paz 22- La Paz 23- La Paz 24- La Paz 25- La Paz 26- La Paz 27- La Paz 28- La Paz 29- La Paz 30- La Paz	L - LA LIBERTAD 1- La Libertad 2- La Libertad 3- La Libertad 4- La Libertad 5- La Libertad 6- La Libertad 7- La Libertad 8- La Libertad 9- La Libertad 10- La Libertad 11- La Libertad 12- La Libertad 13- La Libertad 14- La Libertad 15- La Libertad 16- La Libertad 17- La Libertad 18- La Libertad 19- La Libertad 20- La Libertad 21- La Libertad 22- La Libertad 23- La Libertad 24- La Libertad 25- La Libertad 26- La Libertad 27- La Libertad 28- La Libertad 29- La Libertad 30- La Libertad	H - AHUACHAPAN 1- Ahuachapán 2- Ahuachapán 3- Ahuachapán 4- Ahuachapán 5- Ahuachapán 6- Ahuachapán 7- Ahuachapán 8- Ahuachapán 9- Ahuachapán 10- Ahuachapán 11- Ahuachapán 12- Ahuachapán 13- Ahuachapán 14- Ahuachapán 15- Ahuachapán 16- Ahuachapán 17- Ahuachapán 18- Ahuachapán 19- Ahuachapán 20- Ahuachapán 21- Ahuachapán 22- Ahuachapán 23- Ahuachapán 24- Ahuachapán 25- Ahuachapán 26- Ahuachapán 27- Ahuachapán 28- Ahuachapán 29- Ahuachapán 30- Ahuachapán

Figure.E.3 LOCATION OF TIDE OBSERVATORIES

Comparison of daily rainfall by self-recording and manual gauges
Olomega Station



Comparison of daily rainfall by self-recording and manual gauges
; Jucuaran station

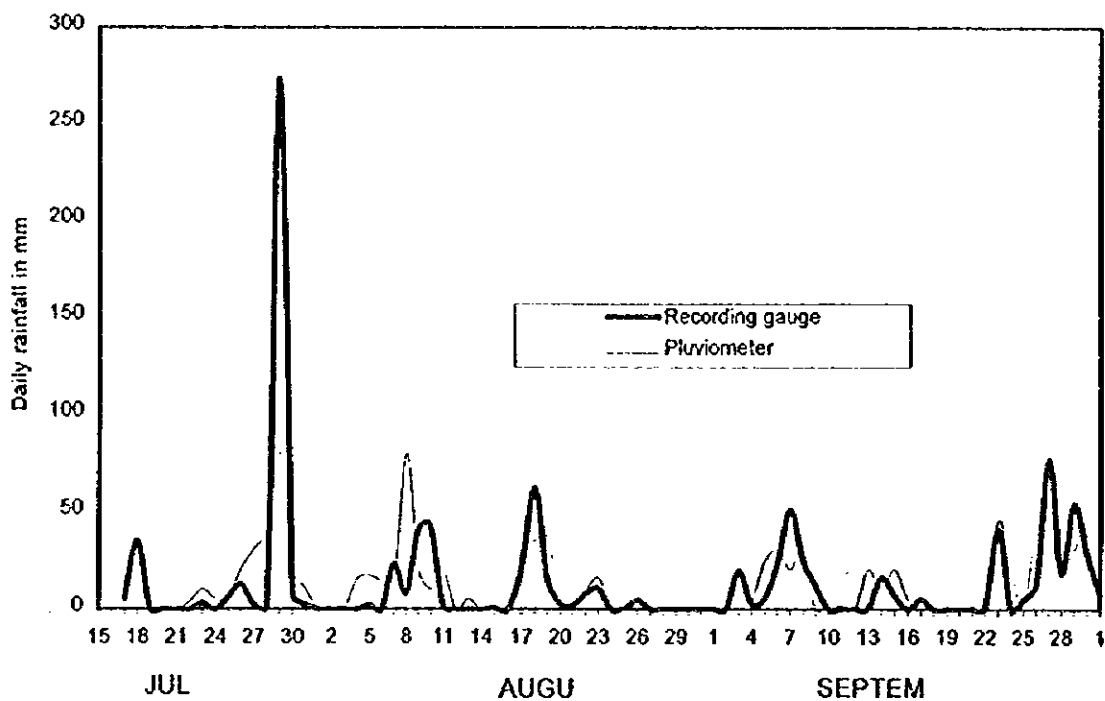
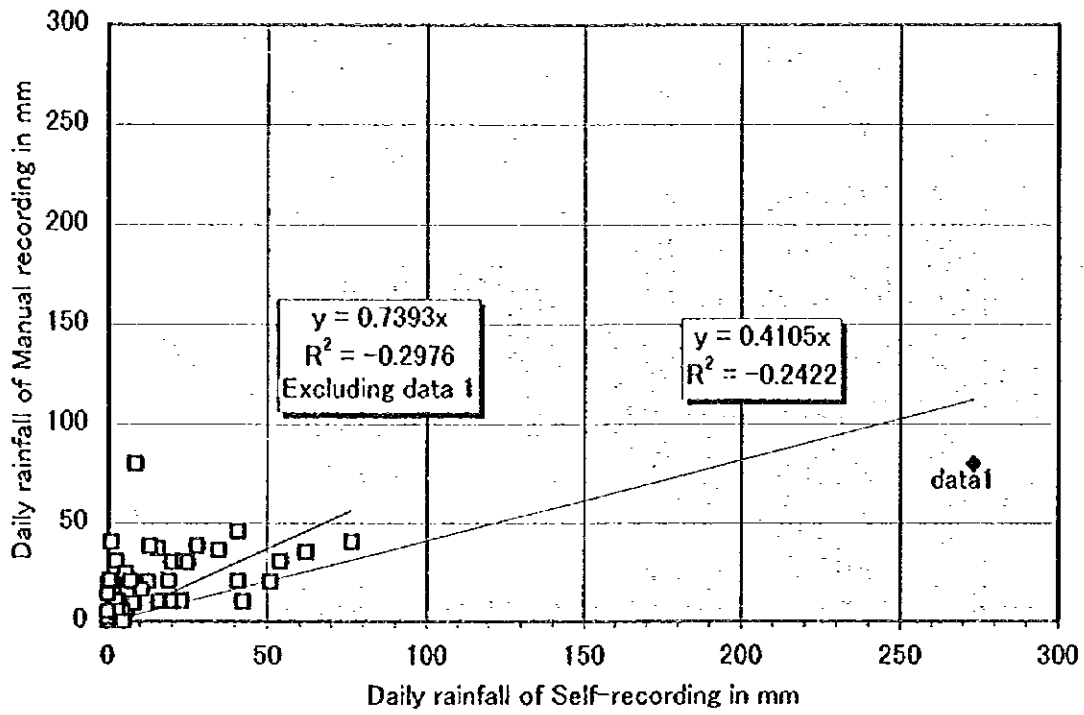


Figure.B.4 COMPARISON OF DAILY RAINFALL BY SELF-RECORDING AND MANUAL GAUGE

Corelation at Jucuaran station



Corelation at Olomega station

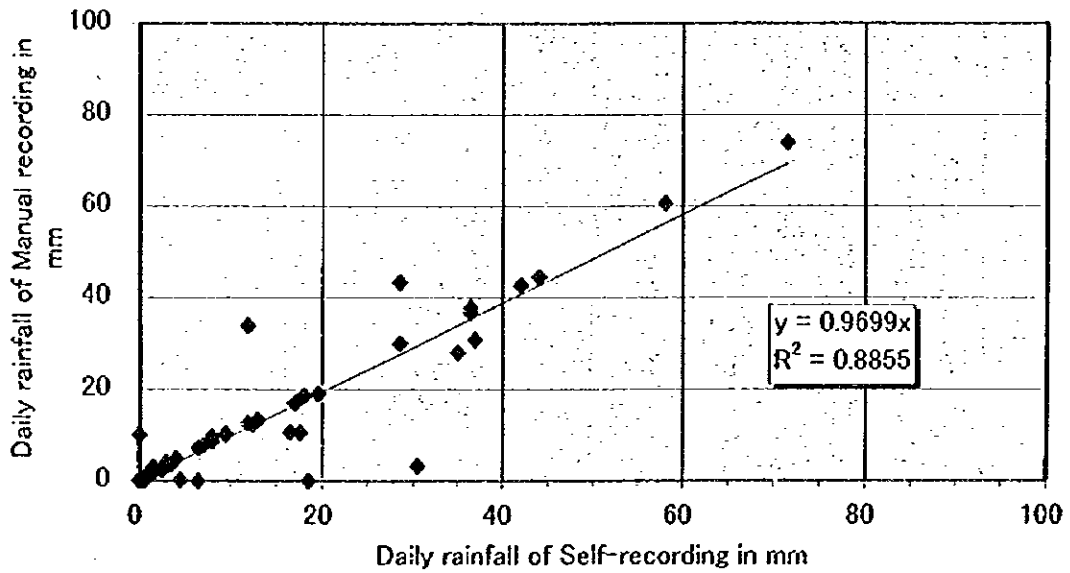
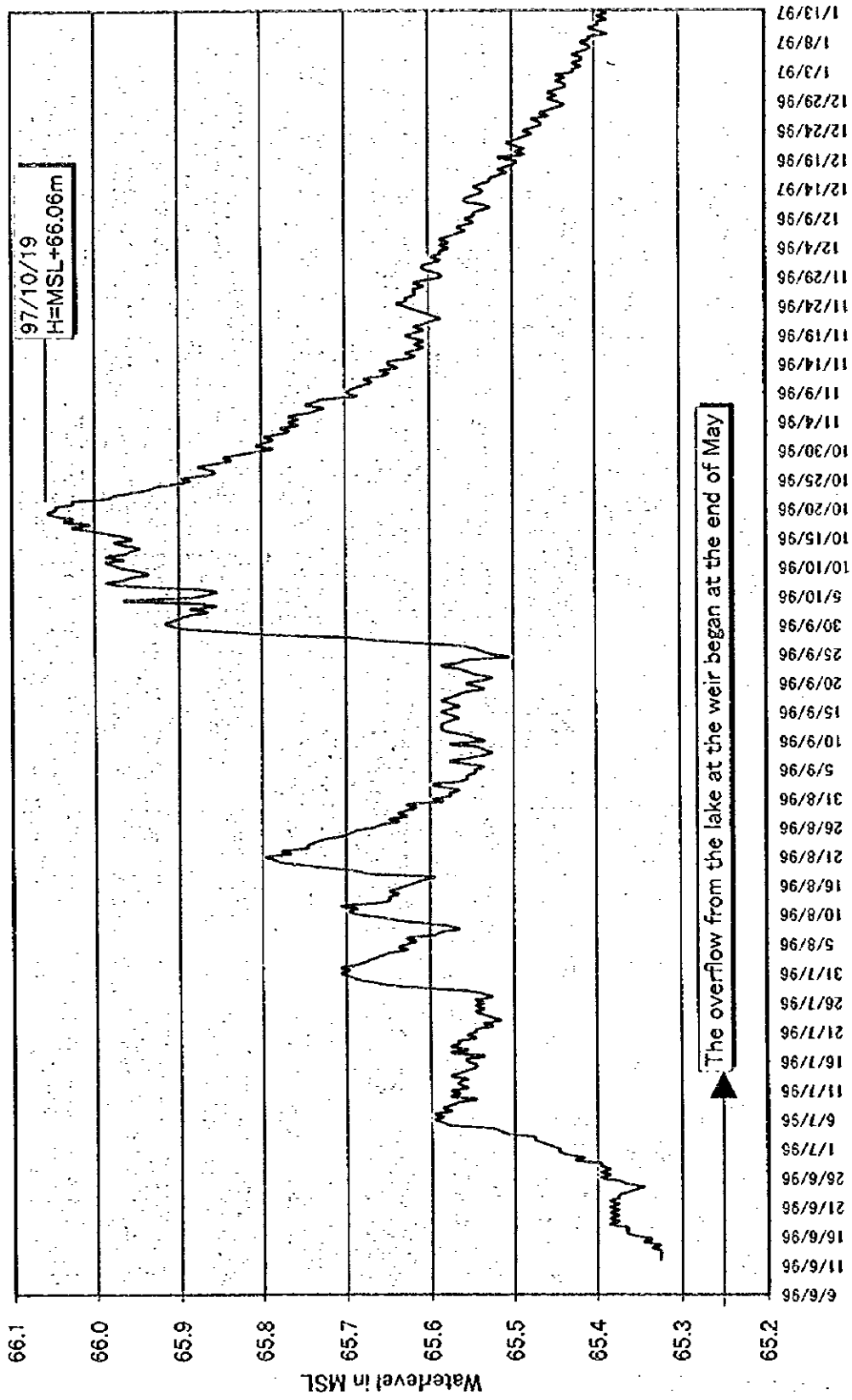
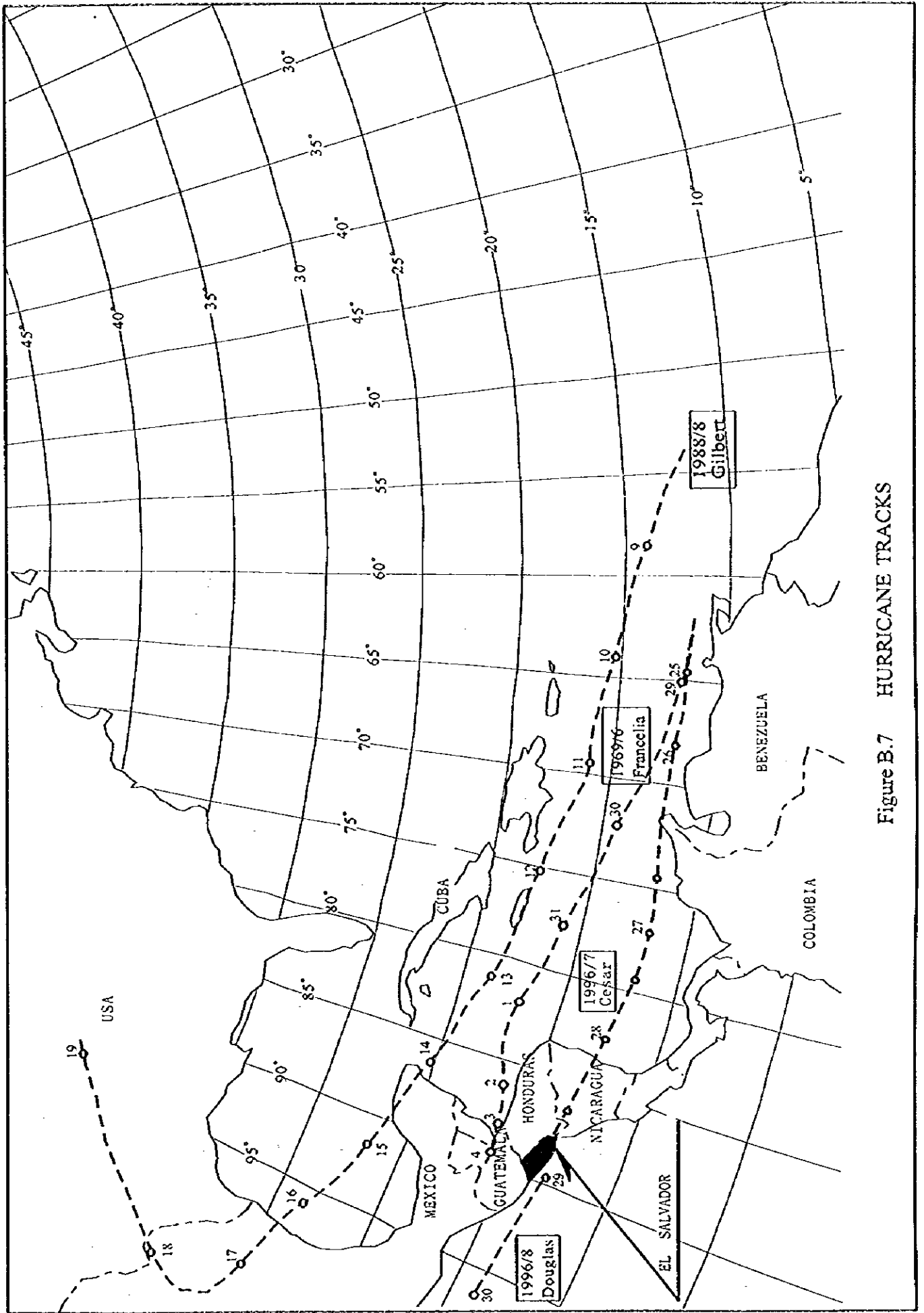


Figure.B.5 CORELATION BETWEEN MANUAL RECORDED AND SELF-RECORDED DATA(DAILY RAINFALL)

Figure.B.6 WATERLEVEL OF LAKE OMEGA(PUERTO VIEJO) IN 1996





B.F.7

Figure B.7 HURRICANE TRACKS

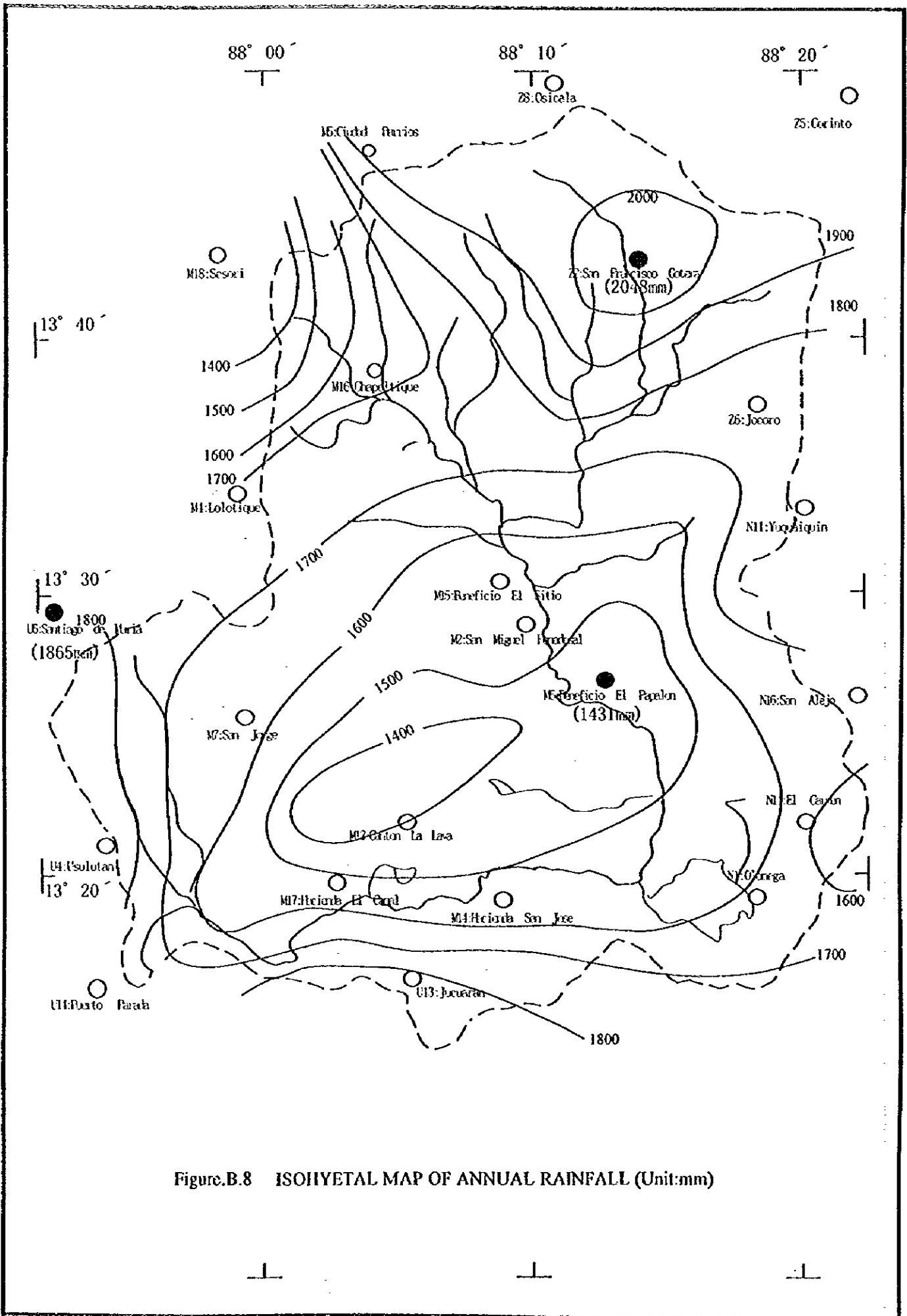


Figure.B.8 ISOHYETAL MAP OF ANNUAL RAINFALL (Unit:mm)

Figure.B.9 REDUCTION OF 1DAY RAINFALL

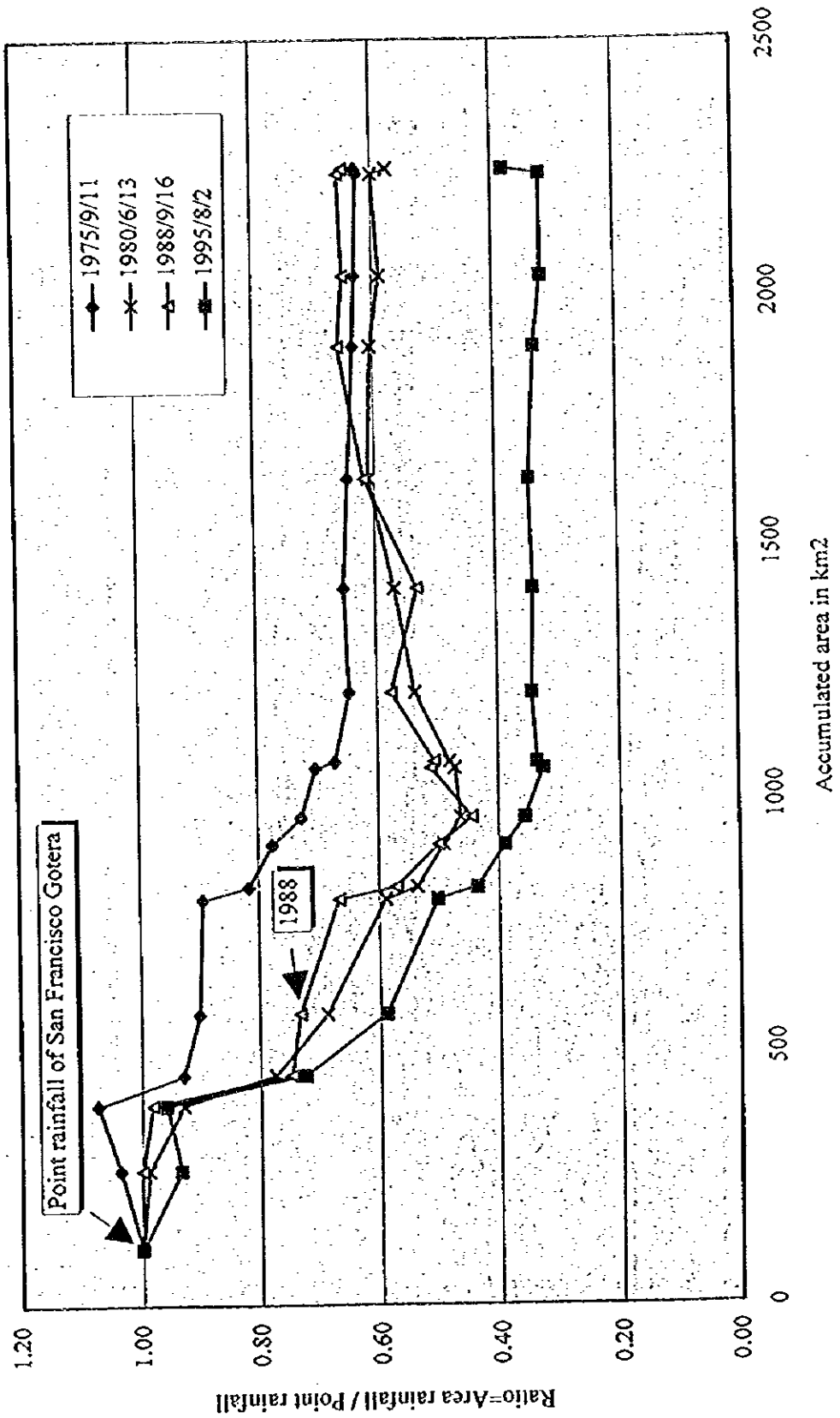


Figure.B.10 REDUCTION CURVES OF 7DAYS RAINFALL

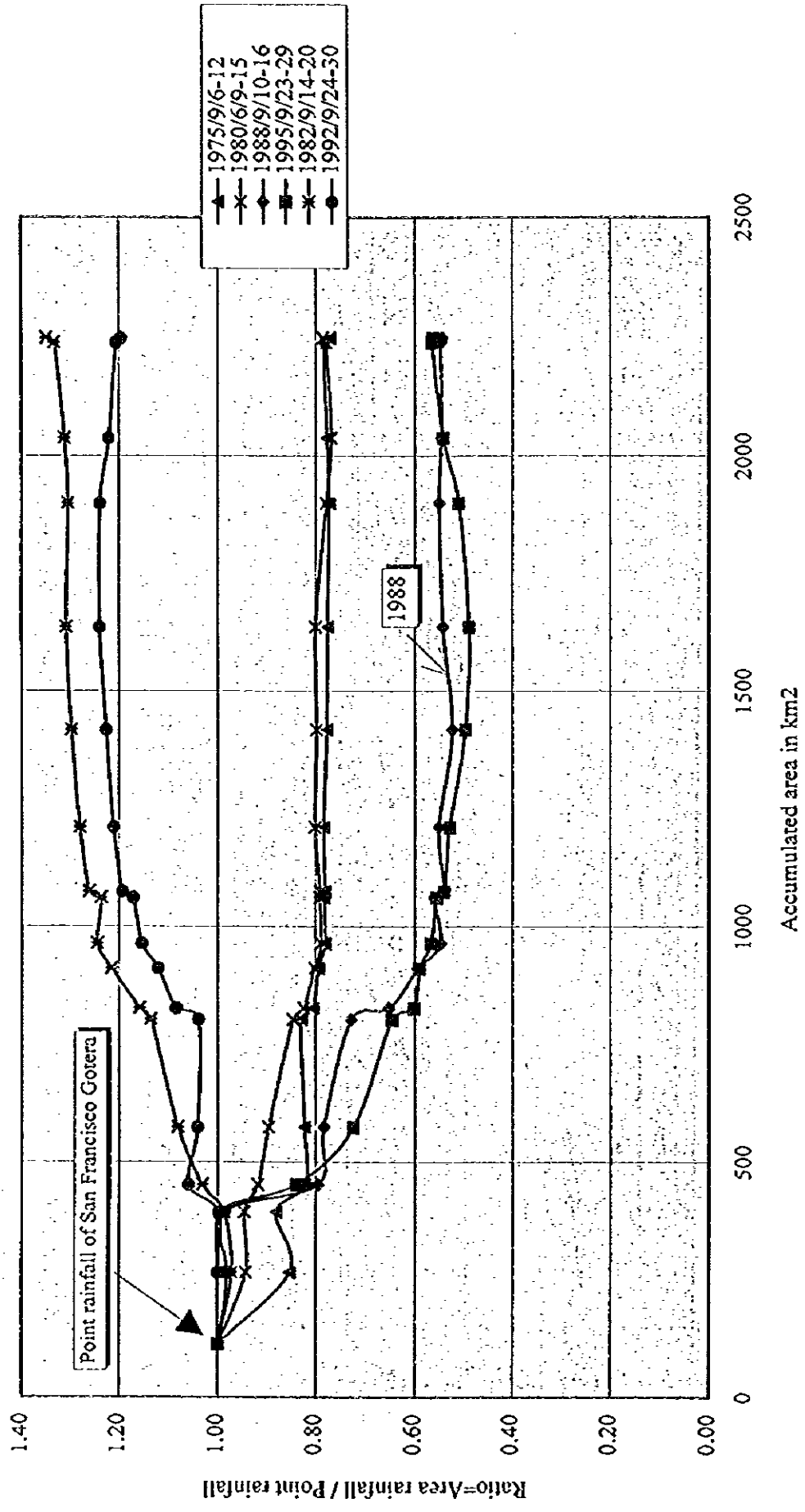


Figure.B.11 DAILY RAINFALL DURING AUG.-OCT. IN 1988 (1/2)

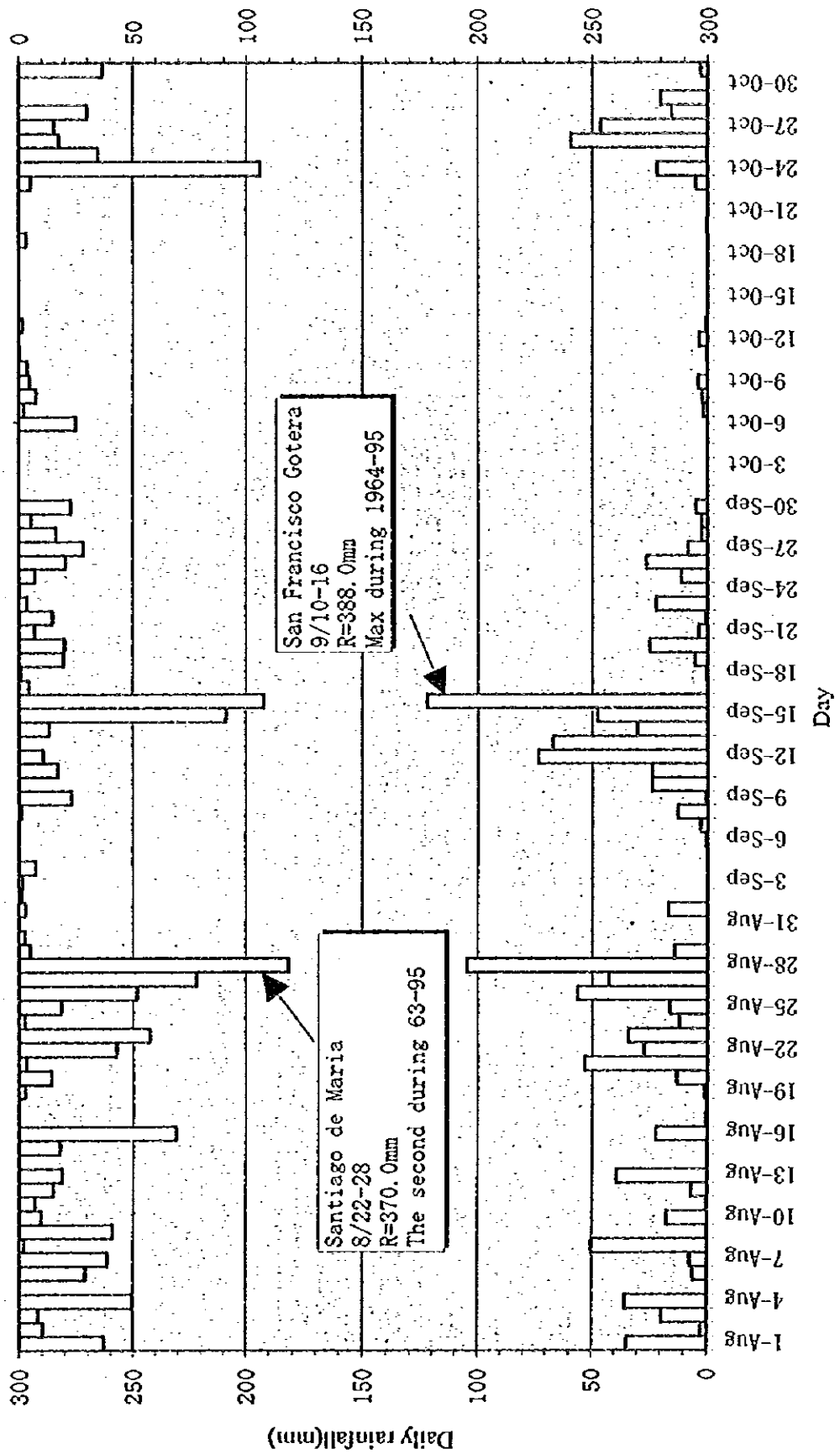


Figure.B.11 DAILY RAINFALL DURING AUG.-OCT. IN 1988 (2/2)

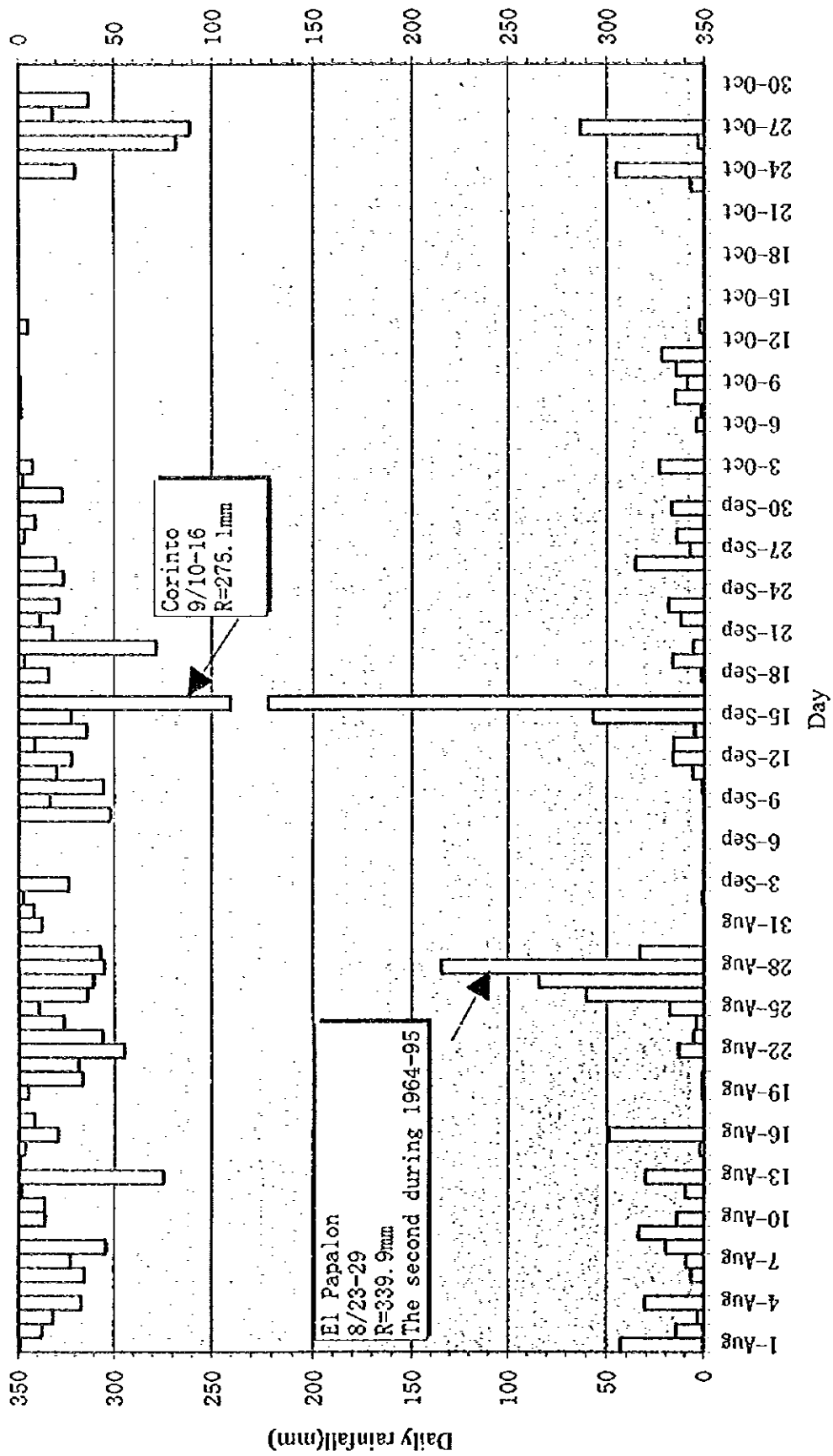
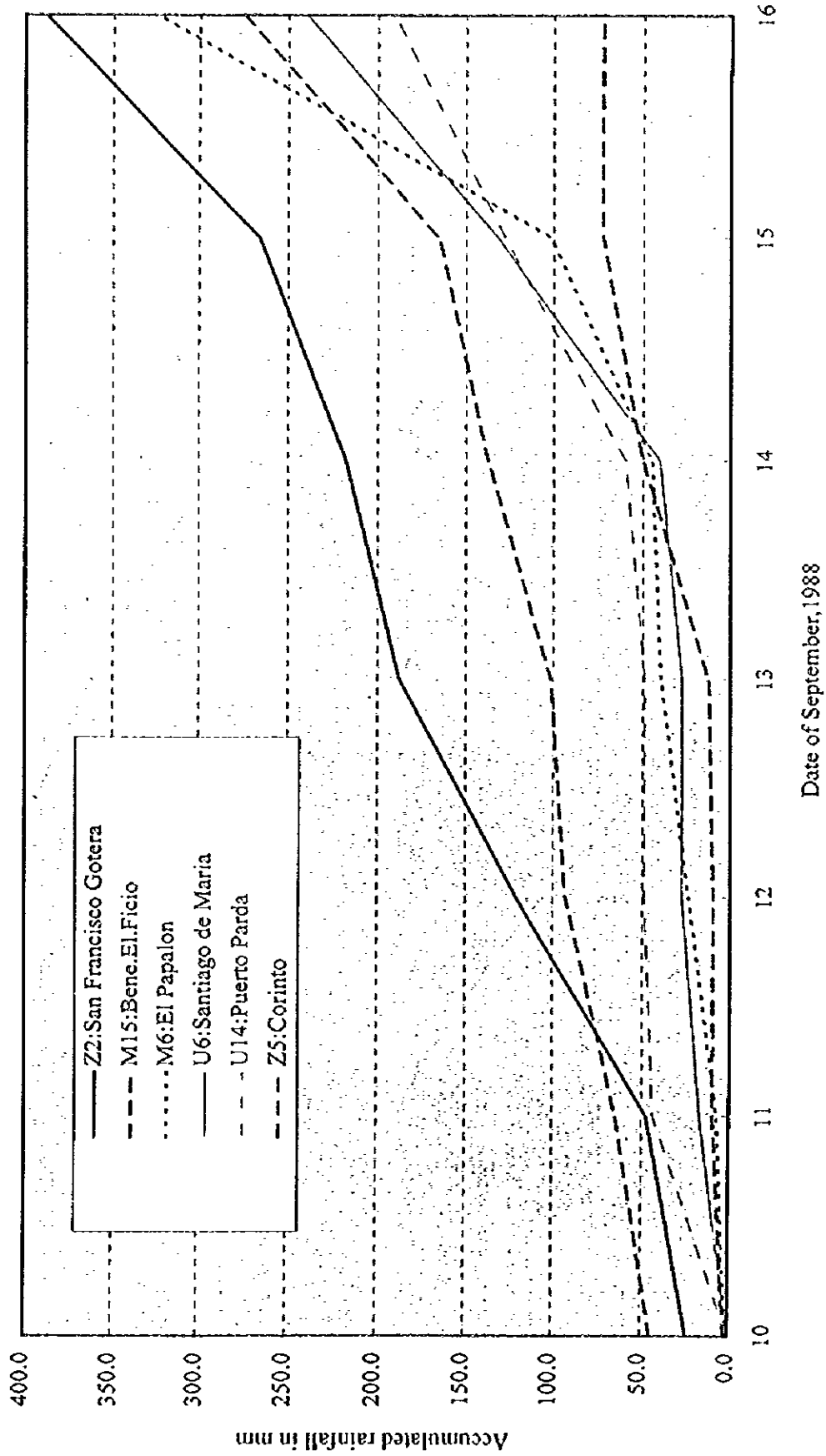


Figure.B.12 MASS CURVES OF DAILY RAINFALL DURING SEP.10-16,1988



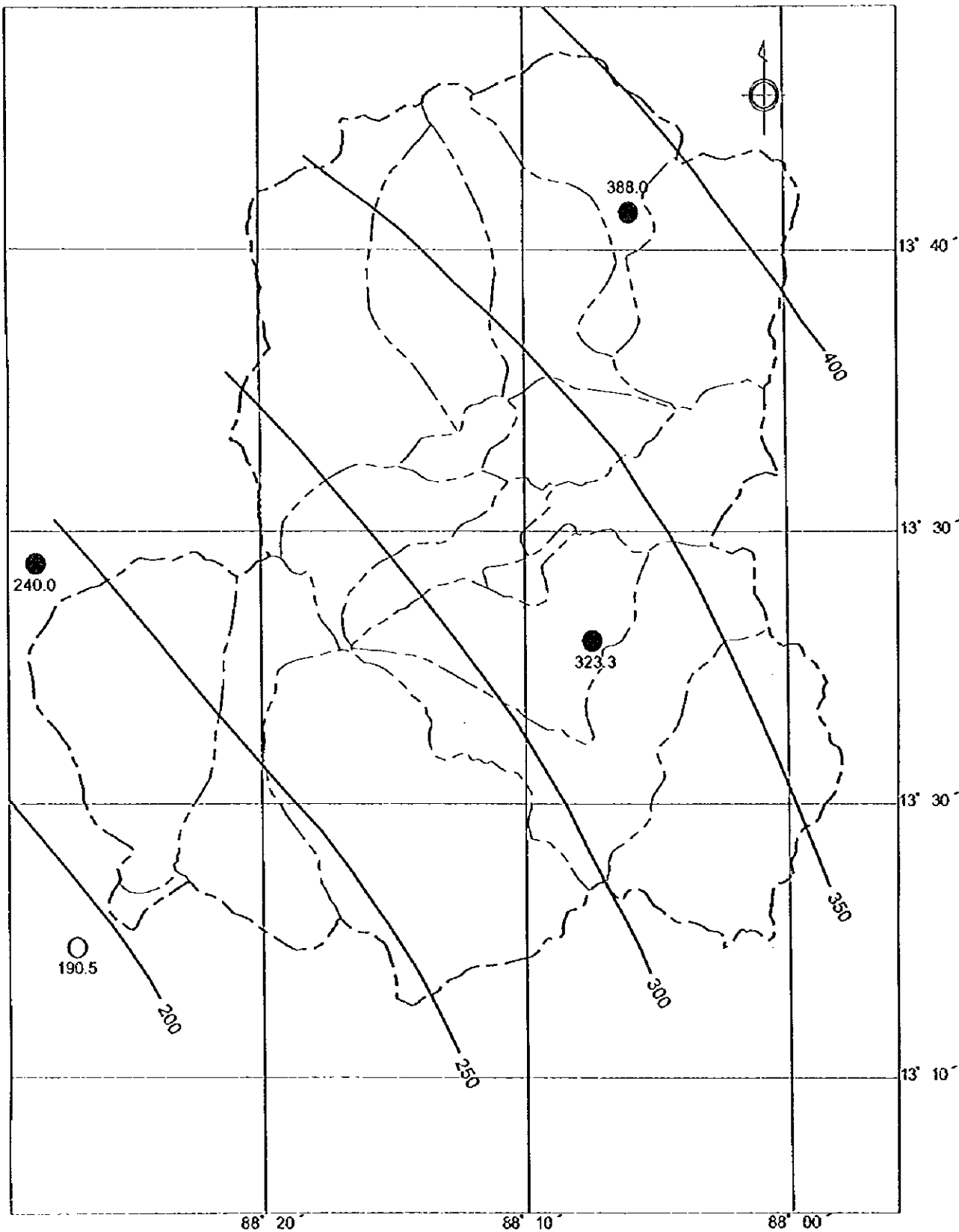


Figure.B.13 ISOHYET LINES OF RAINFALL AMOUNT DURING SEP.10-16,1988

Figure.B.14 MONTHLY AVERAGED DISCHARGE AND RAINFALL BETWEEN 1970-1978

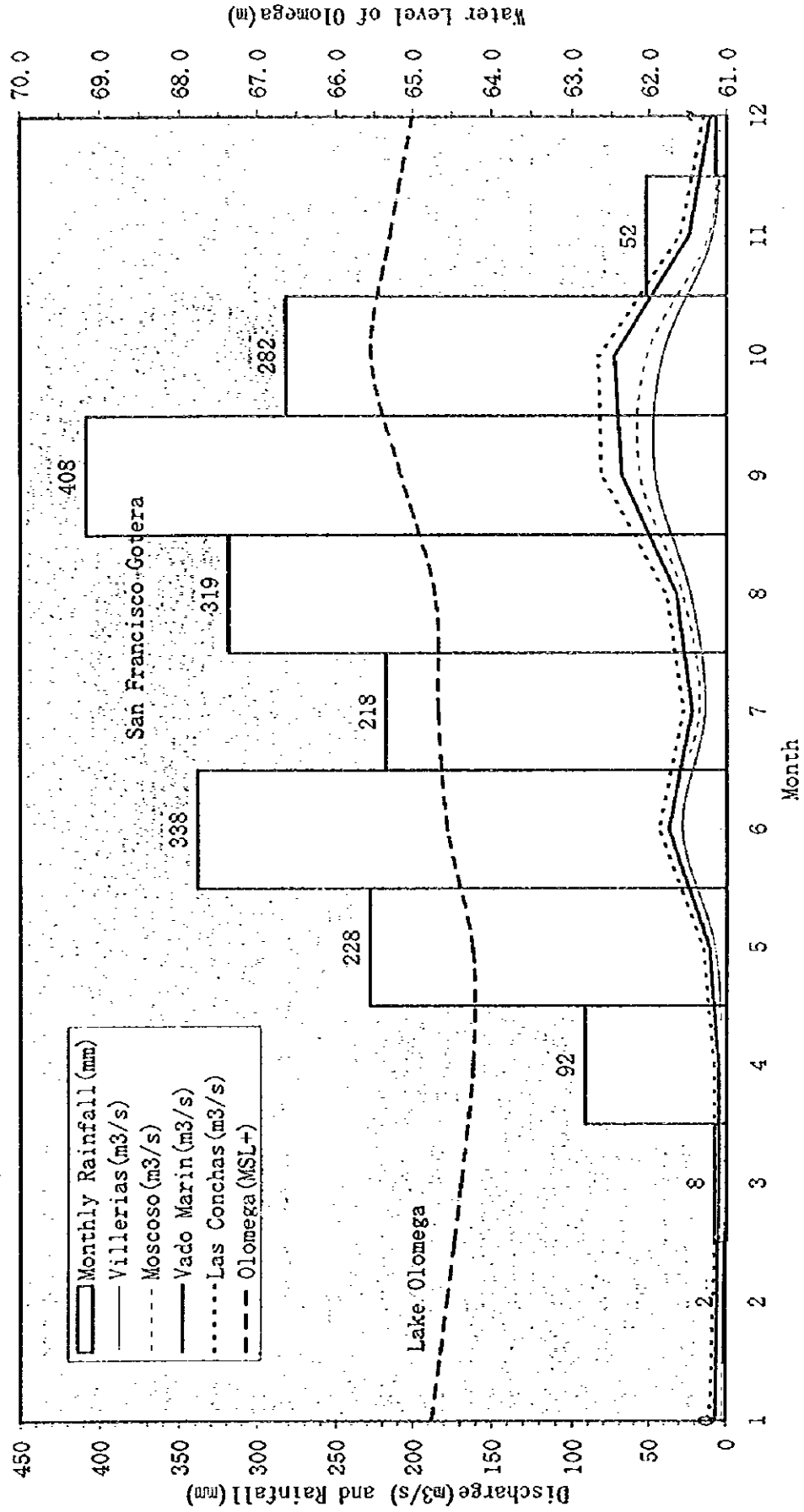
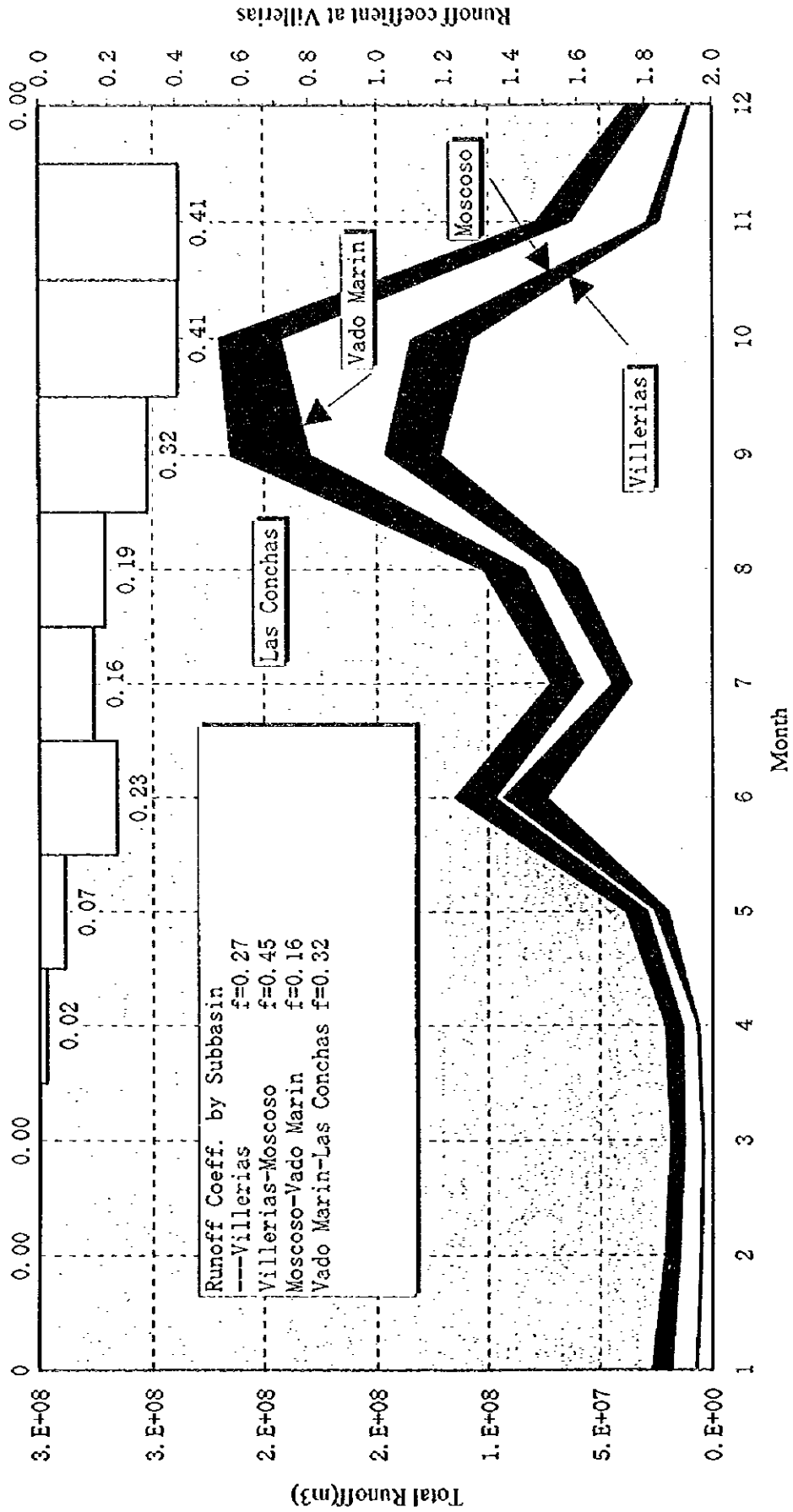
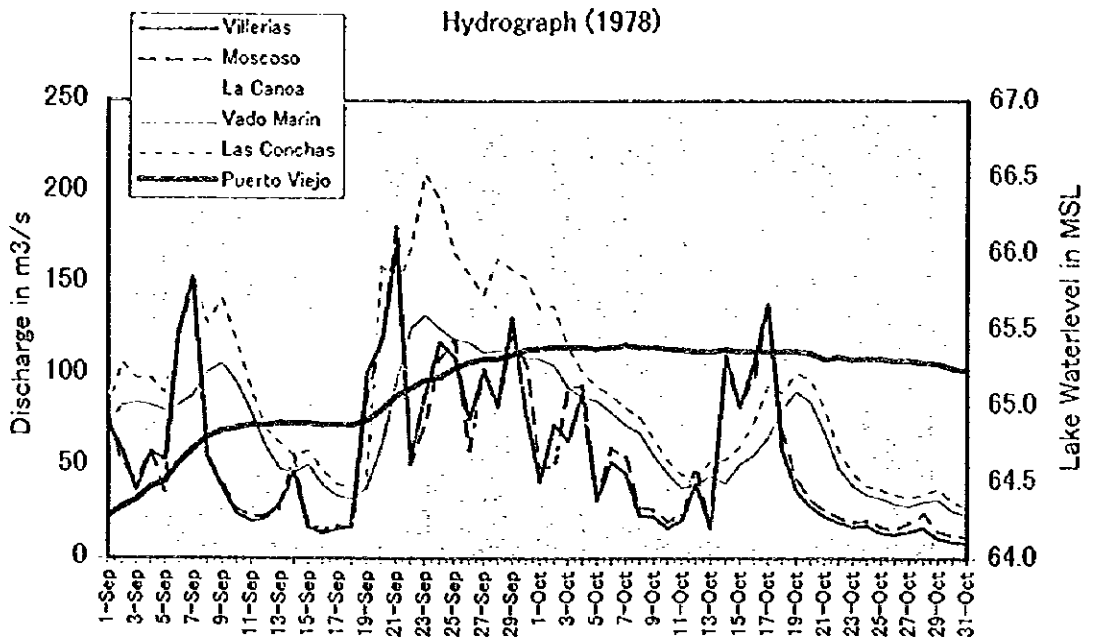
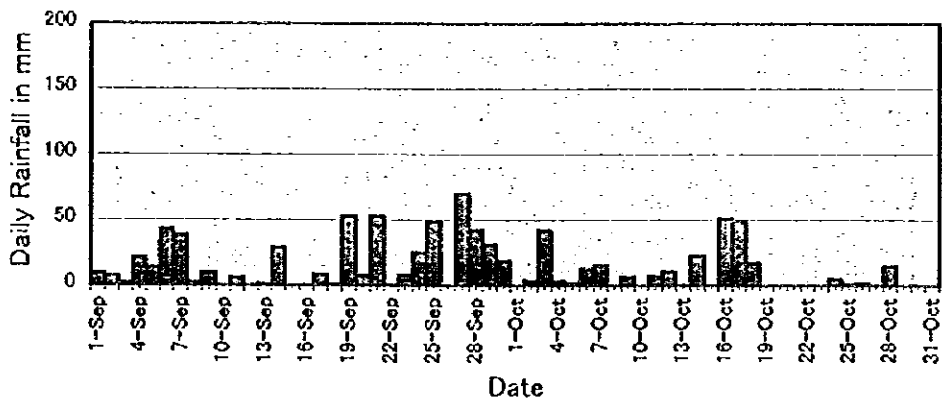


Figure.B.15 VARIATION OF RUNOFF VOLUME AND RUNOFF COEFFICIENT BETWEEN 1970-1978





San Francisco Gotera(1980)



Santiago de Maria

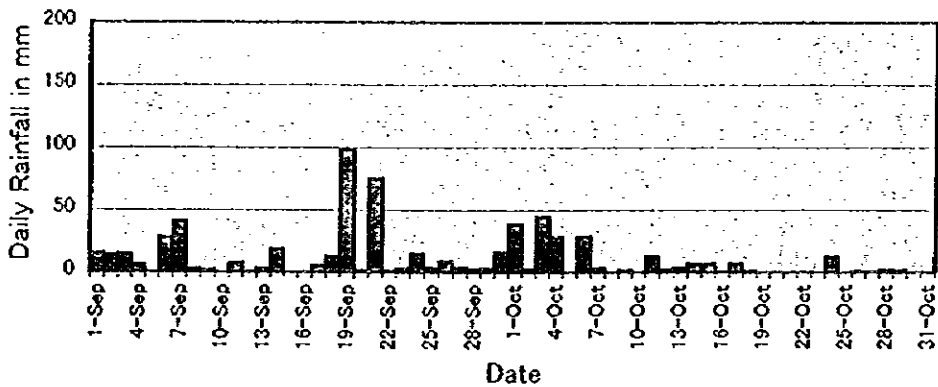
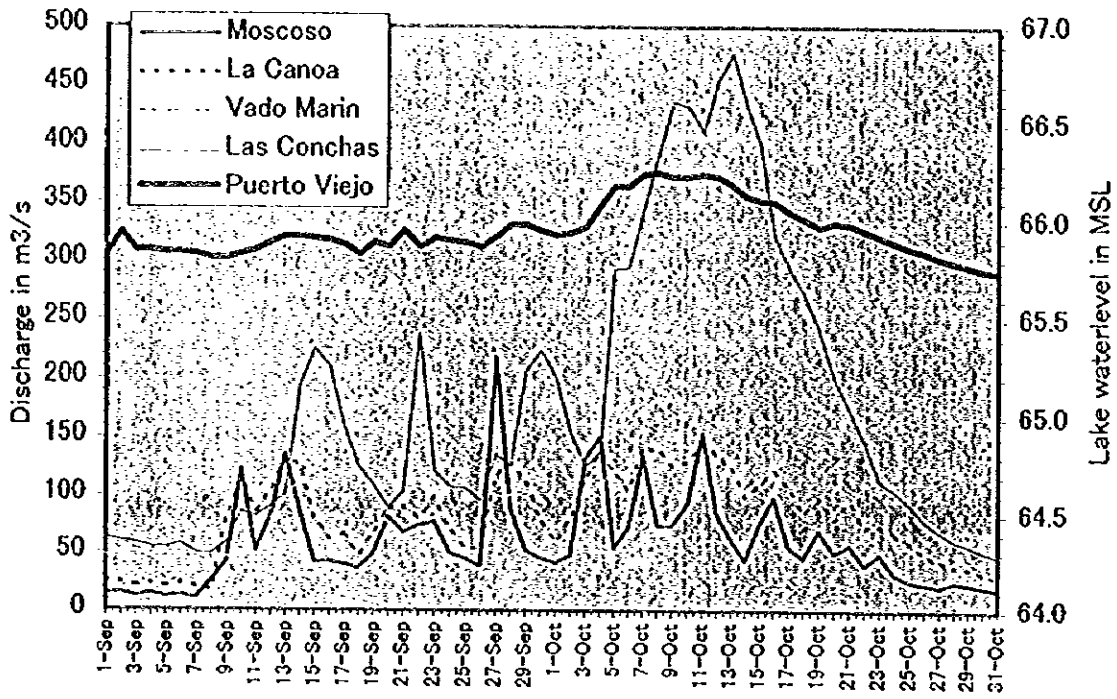
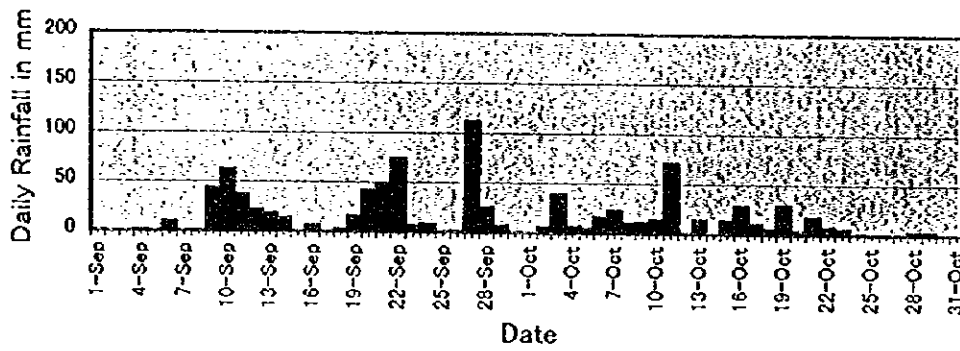


Figure.B.16 HYDROGRAPH AND DAILY RAINFALL IN 1978

Hydrograph(1980)



San Francisco Gotera(1980)



Santiago de Maria(1980)

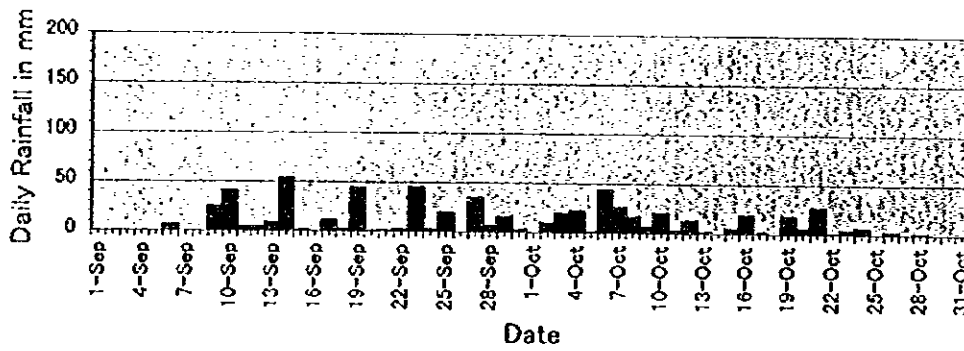
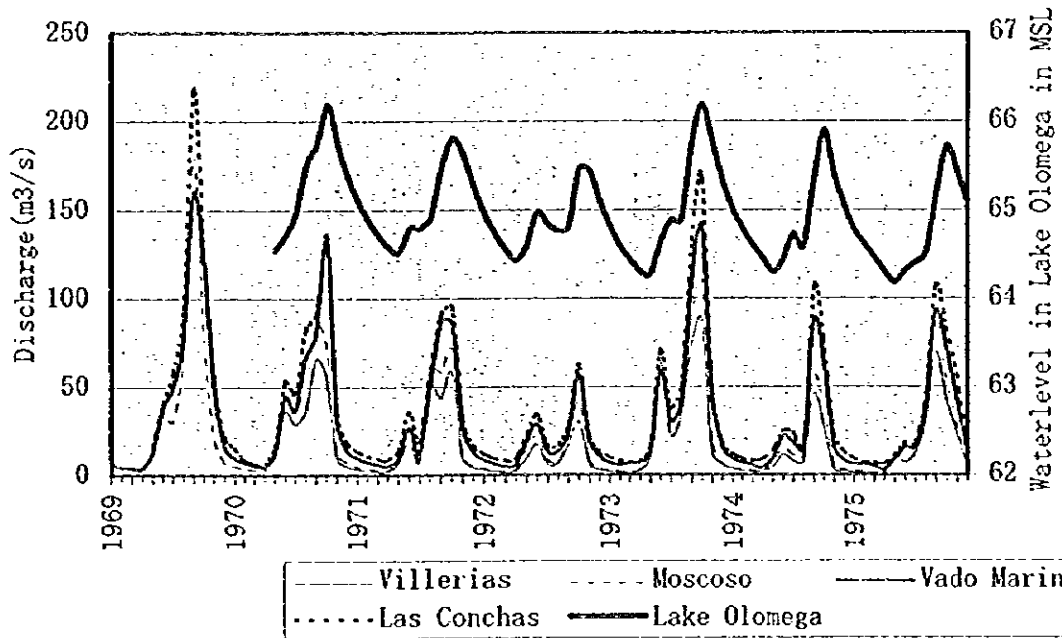


Figure.B.17

HYDROGRAPH AND DAILY RAINFALL IN 1980

1970-1975



1976-1981

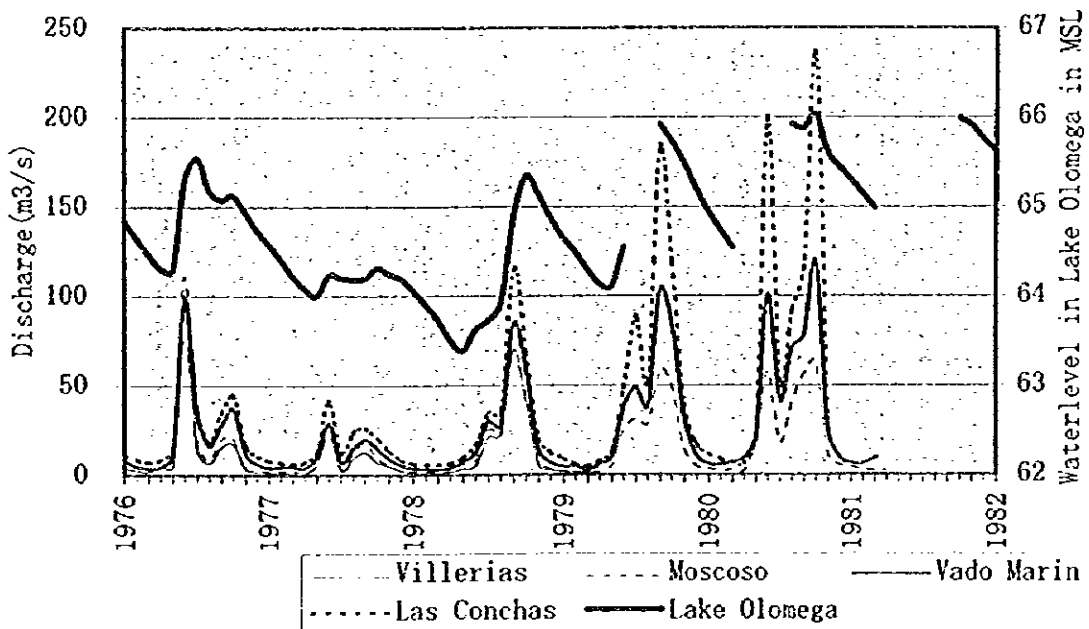


Figure.B.18

MONTHLY DISCHARGES OF STREAM GAUGING STATIONS AND WATERLEVEL OF LAKE OMEGA

Table Area of subbasins in the Study Area

Subbasin Number	Location	Tribrachy	Area (sq. mi.)	Area (sq. km.)
1	Rio San Francisco		112.9	291.6
2	Rio Sapo		153.5	396.7
3	Rio Yahual and Rio San Diego		129.5	334.7
4	Rio San Geronimo		57.5	148.5
5	Rio Villorinas		227.7	589.8
6	Rio Guayabal		34.2	88.6
7	Rio San Esteban		45.0	116.8
8	Villorinas		94.0	243.0
9	Rio Guayabal		97.2	252.2
10	Moscoso		12.8	33.1
11	Moscoso		1074.0	2774.0
12	Jumayac		136.8	353.8
13	Lake Olomega		207.0	537.0
14	Lake Olomega		219.2	566.2
15	Vado Marín		783.0	2023.0
16	Las Conchas		137.7	355.7
17	Las Conchas		199.9	515.9
18	Las Conchas		9.2	23.8

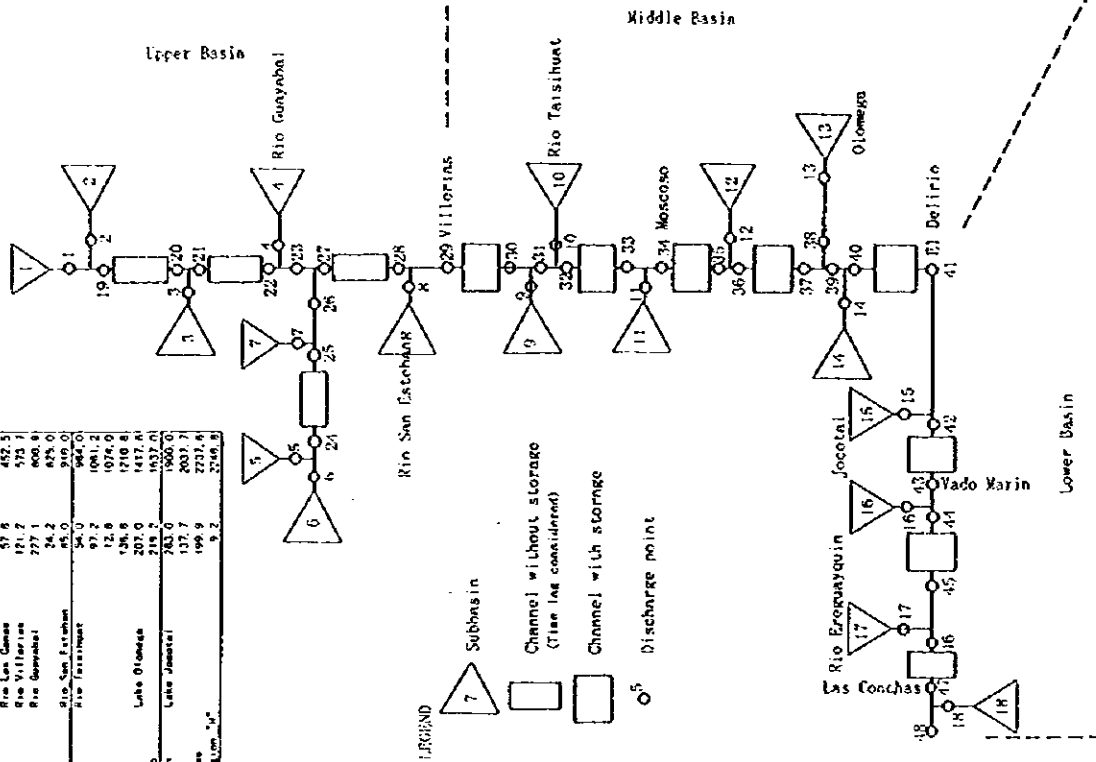
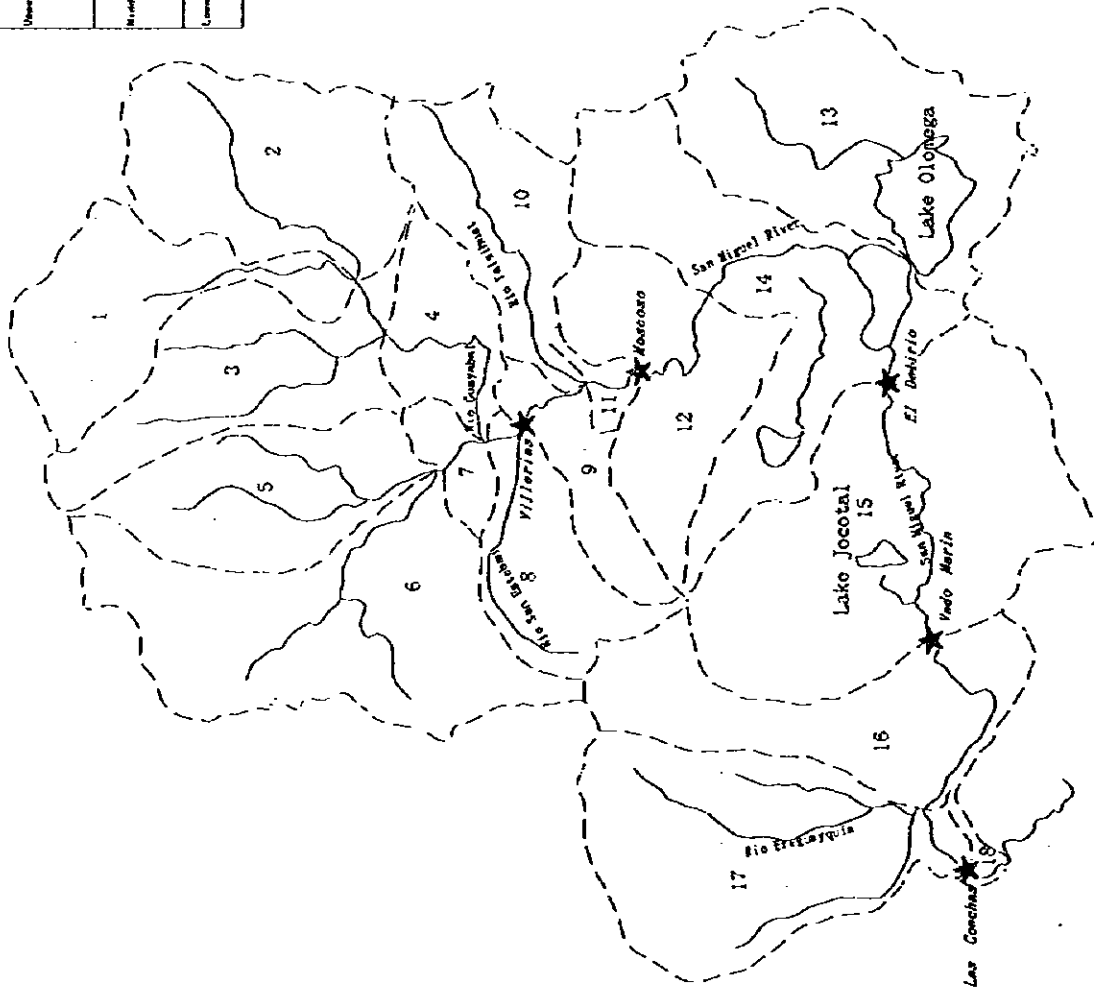
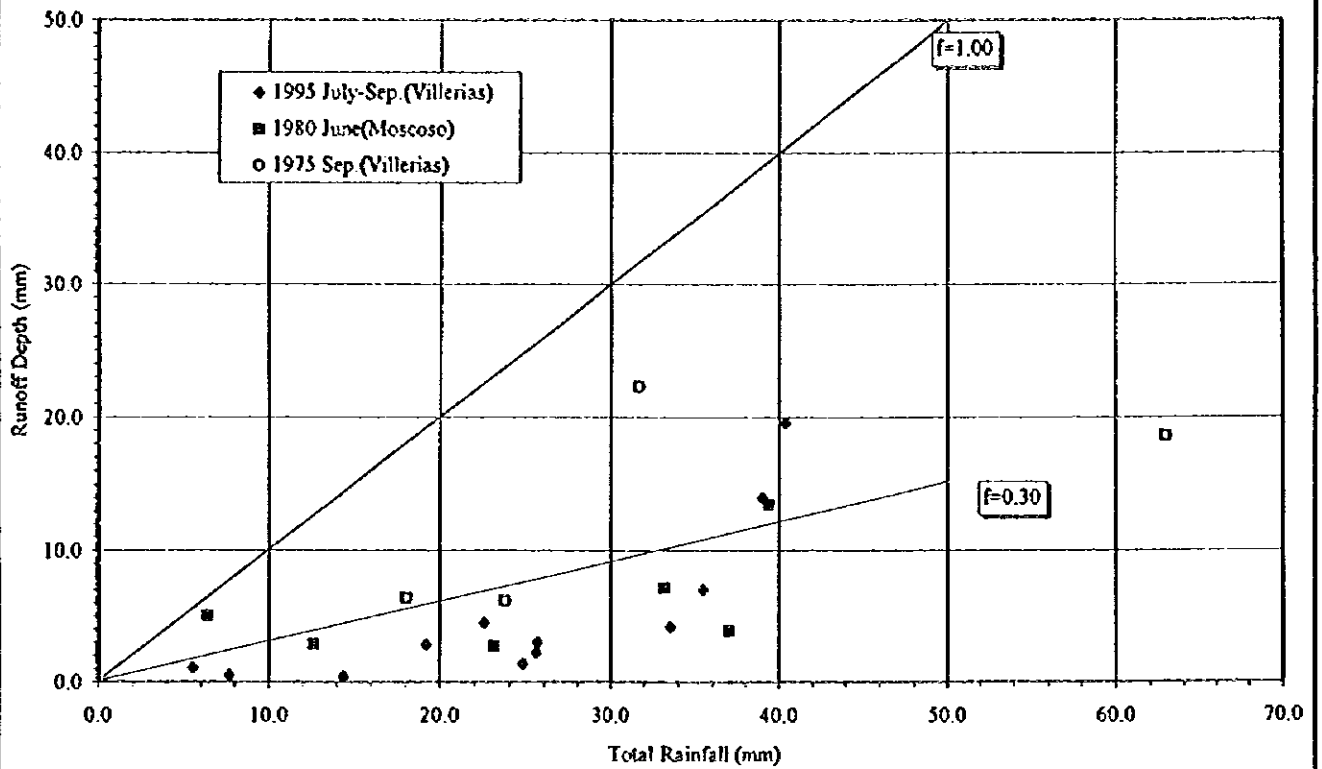


Figure B. 19 RUNOFF SYSTEM DIAGRAM

FIG. 1 Run-off Simulation Model

Figure.B.20 Basin averaged rainfall and Runoff depth at Villerias (Moscoso)



Annual variation of runoff rate at Villerias in 1975

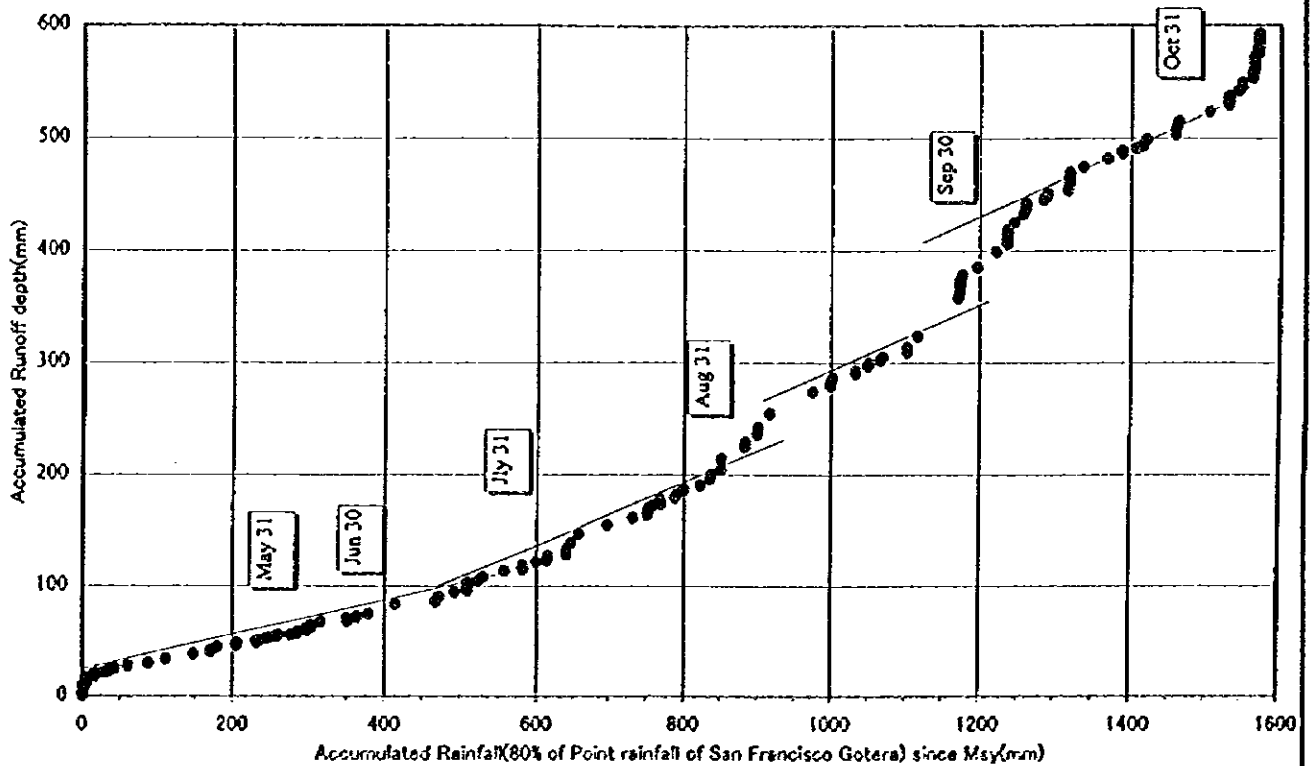


Figure B. 20 BASIN AVERAGED RAINFALL AND RUNOFF DEPTH AT VILLERIAS AND MOSCOSO

Figure.B.21 Basin averaged hourly rainfall at Villerias between July and August in 1995 (1/2)

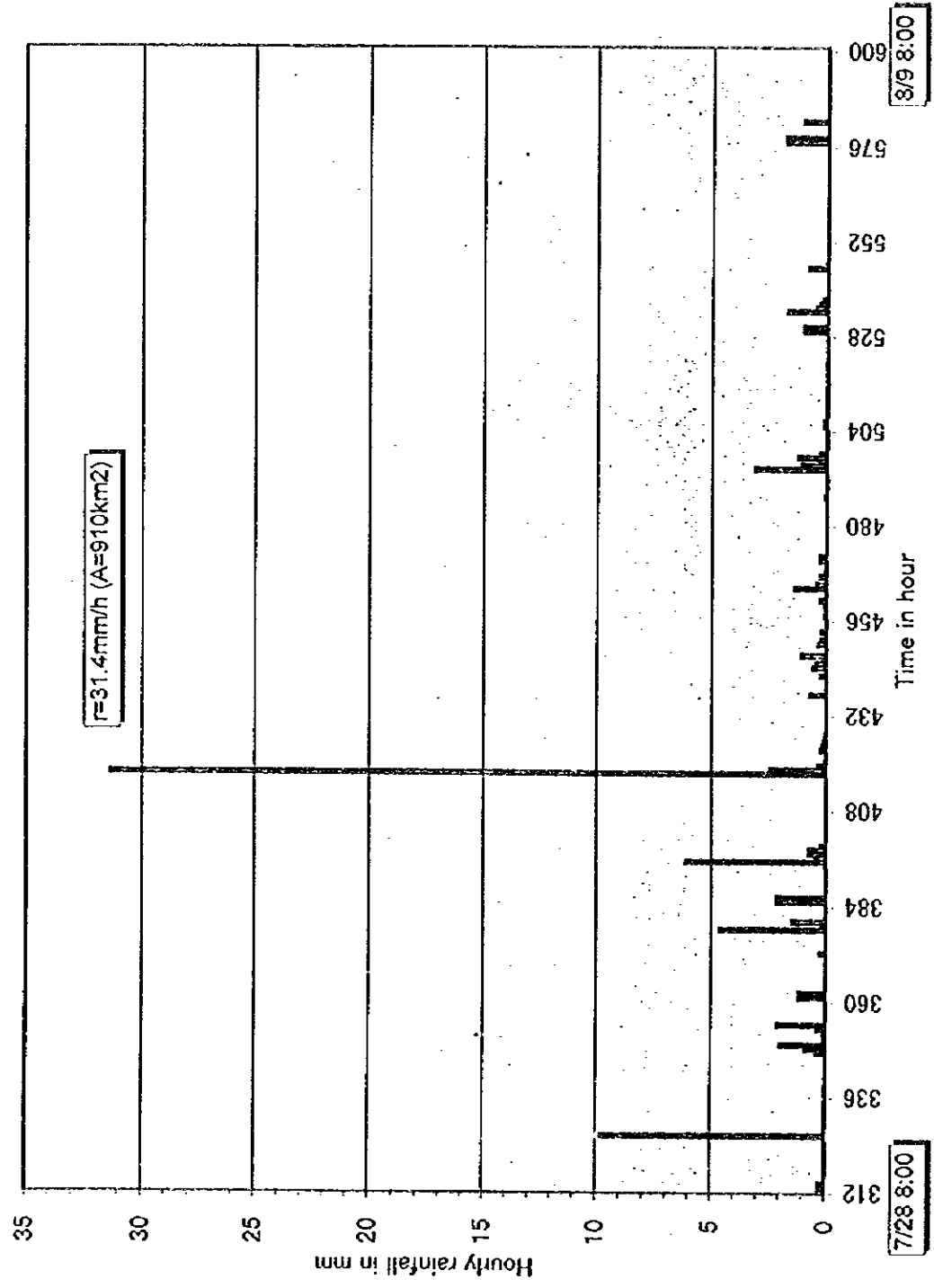


Figure.B.21 Hydrograph at Villerias between July and August in 1995 (22)

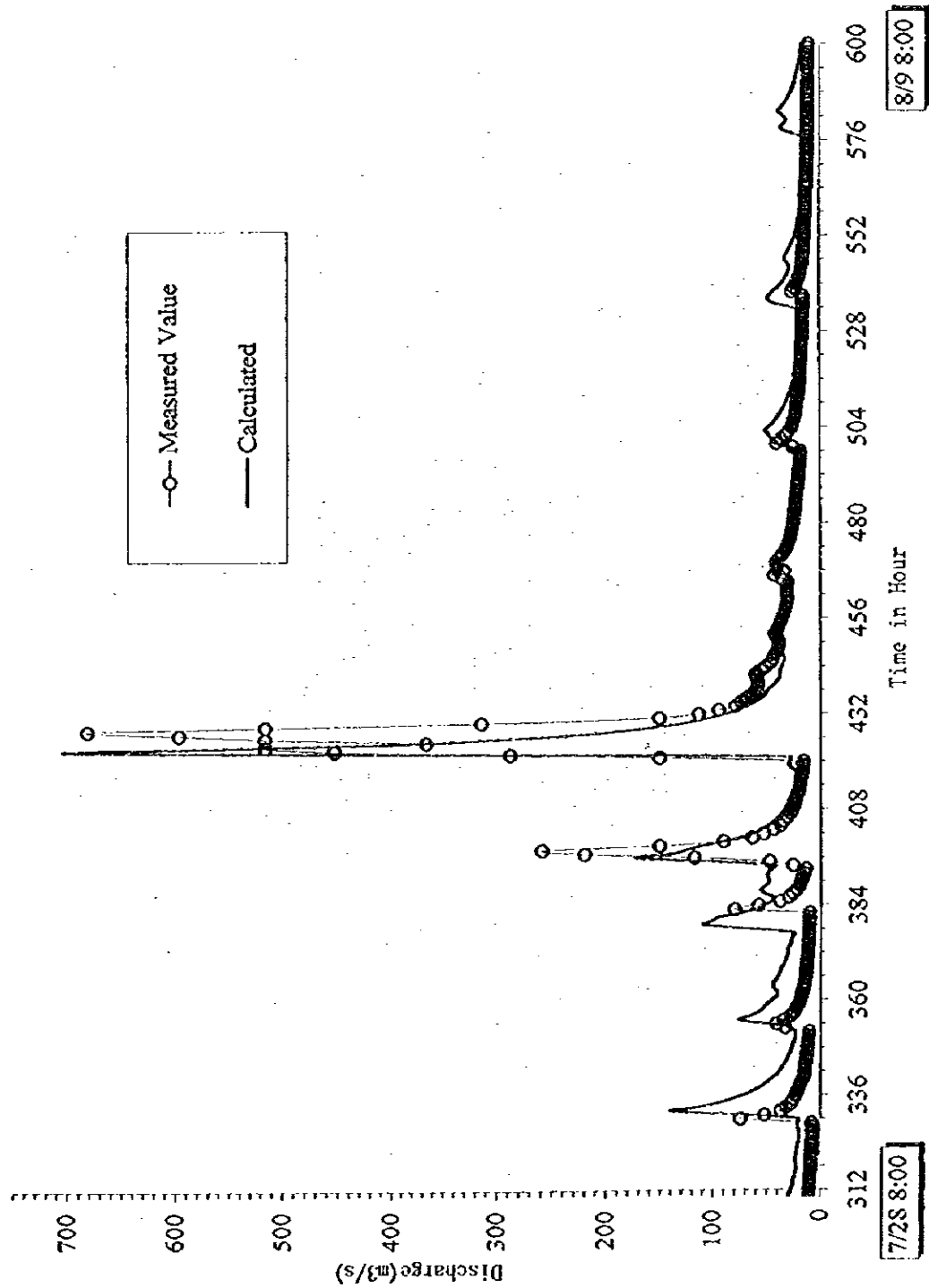
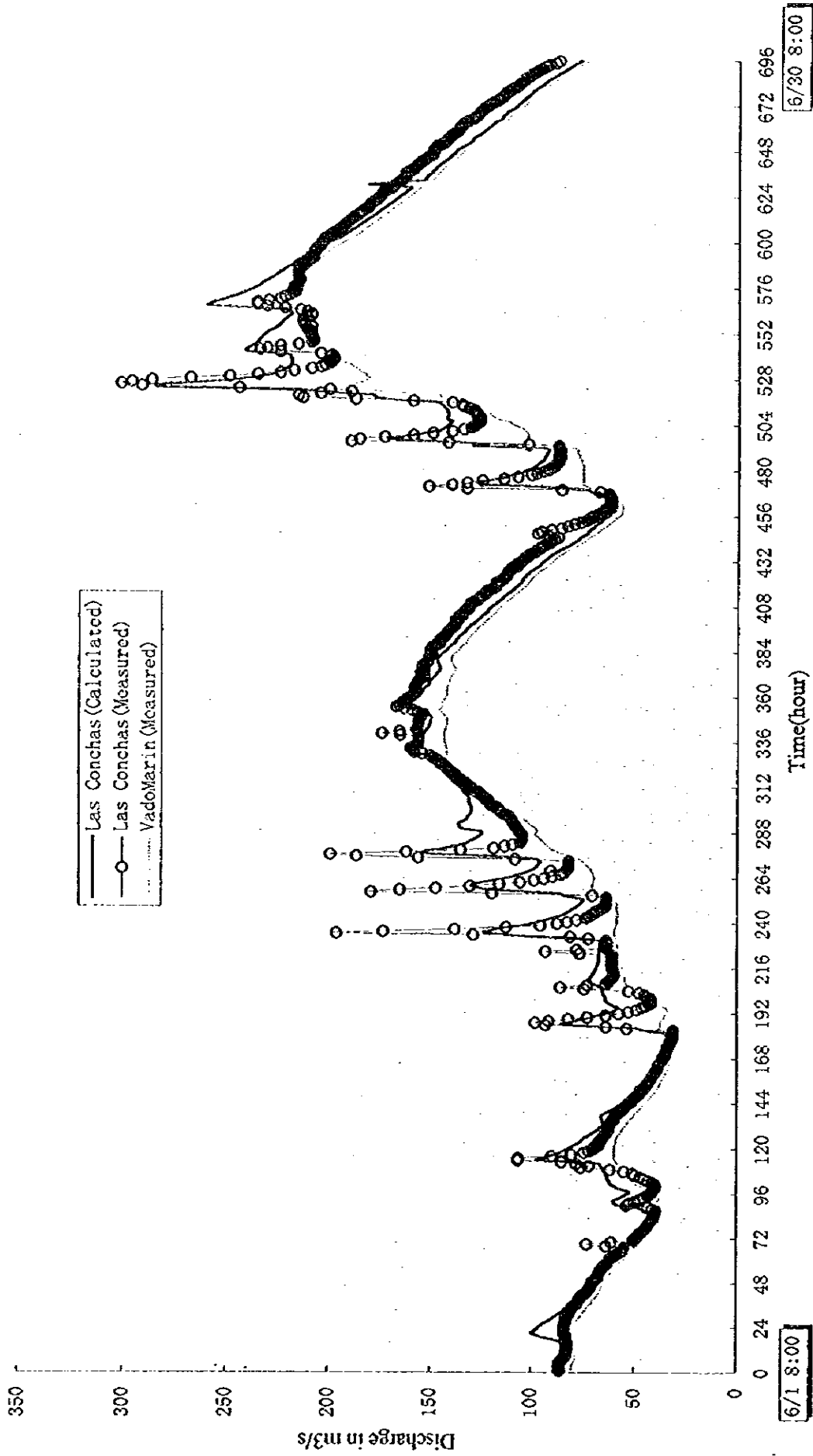


Figure.B.22 Hydrograph of June 1980 flood at Vado Marin and Las Conchas



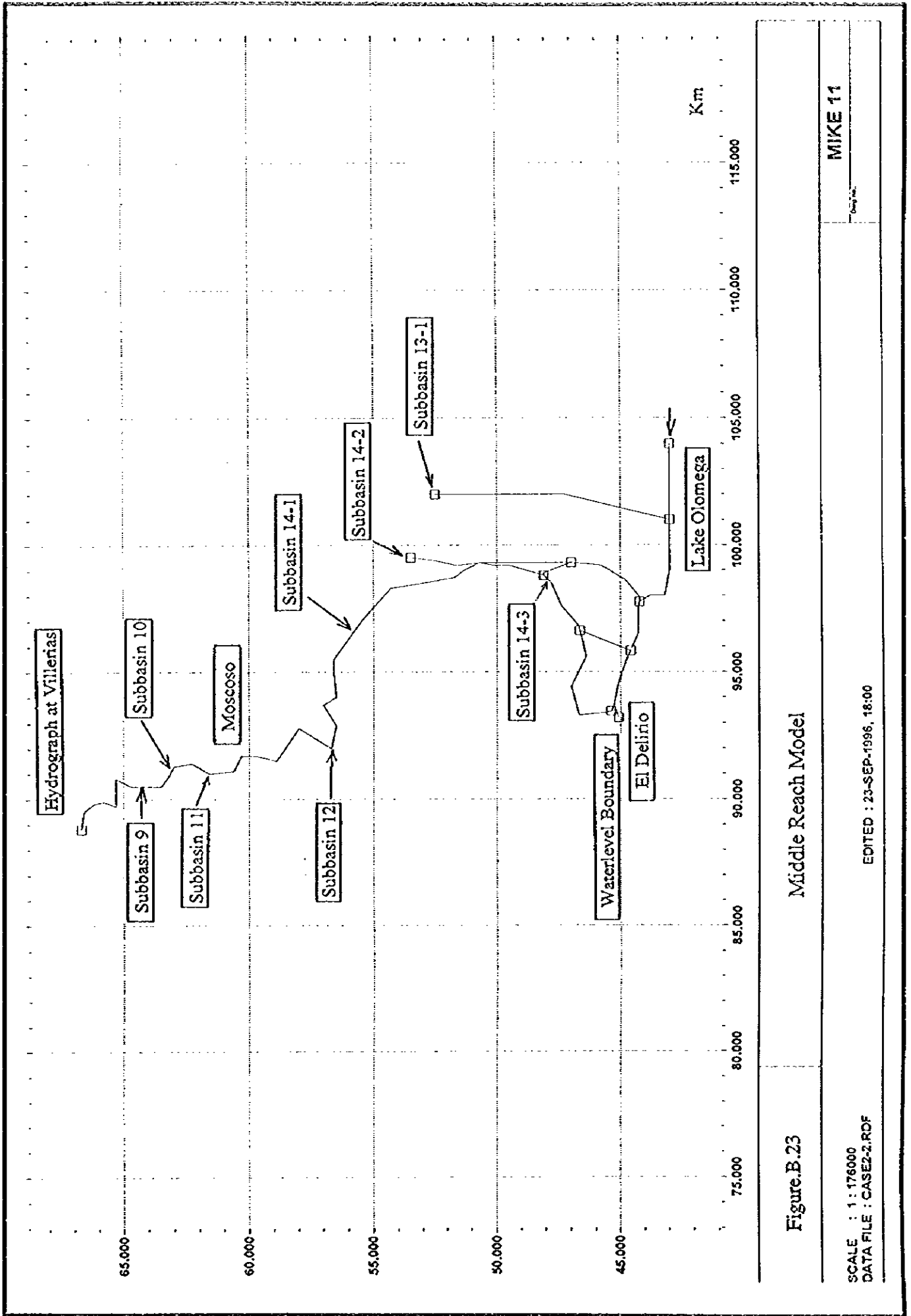


Figure.B.23

Middle Reach Model

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 DATA FILE : CASE2-2.RDF

EDITED : 23-SEP-1996, 18:00

MIKE 11

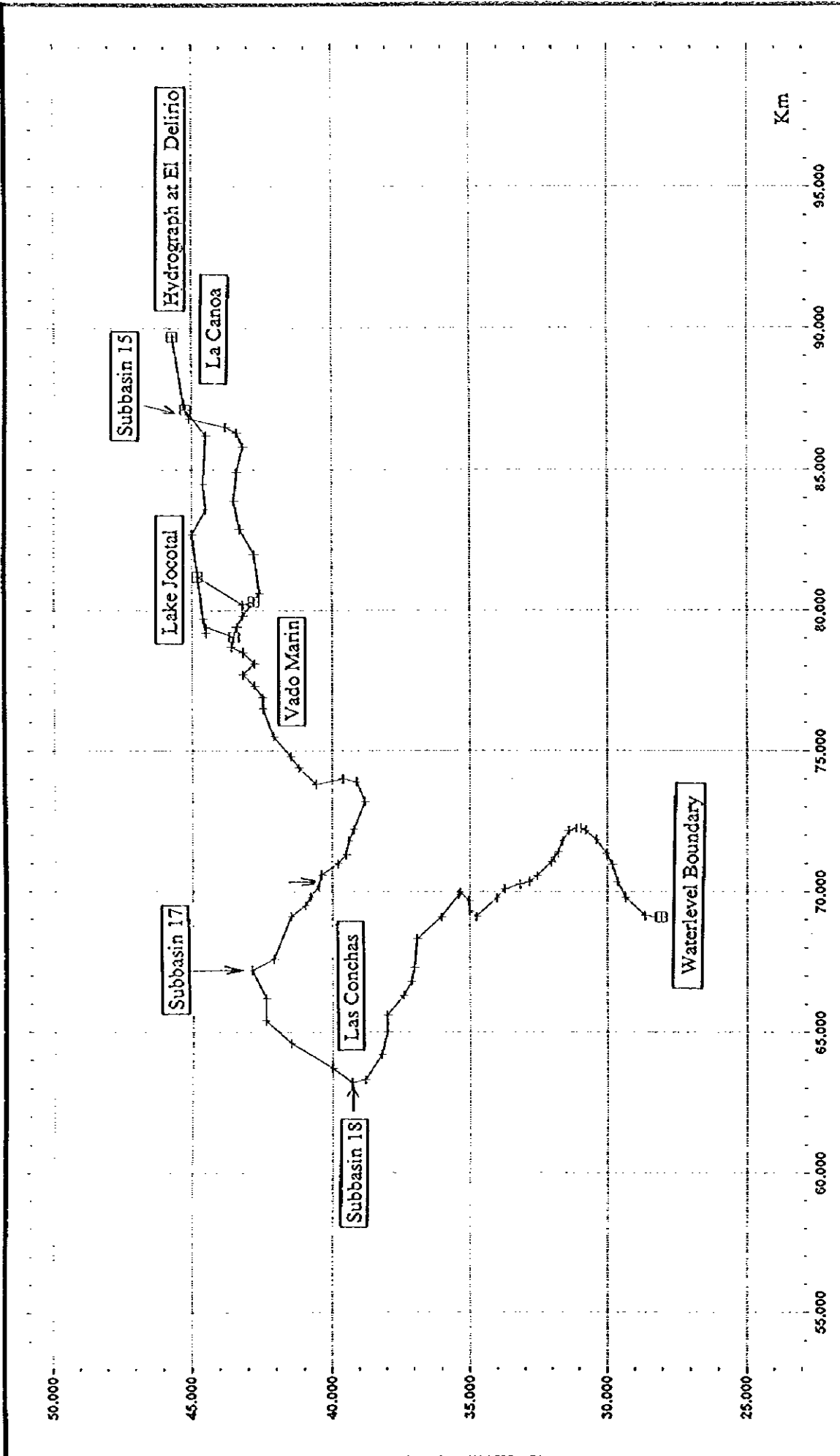


Figure.B.23

Lower Reach Model

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EDITED : 20-SEP-1996, 20:35

MIKE 11

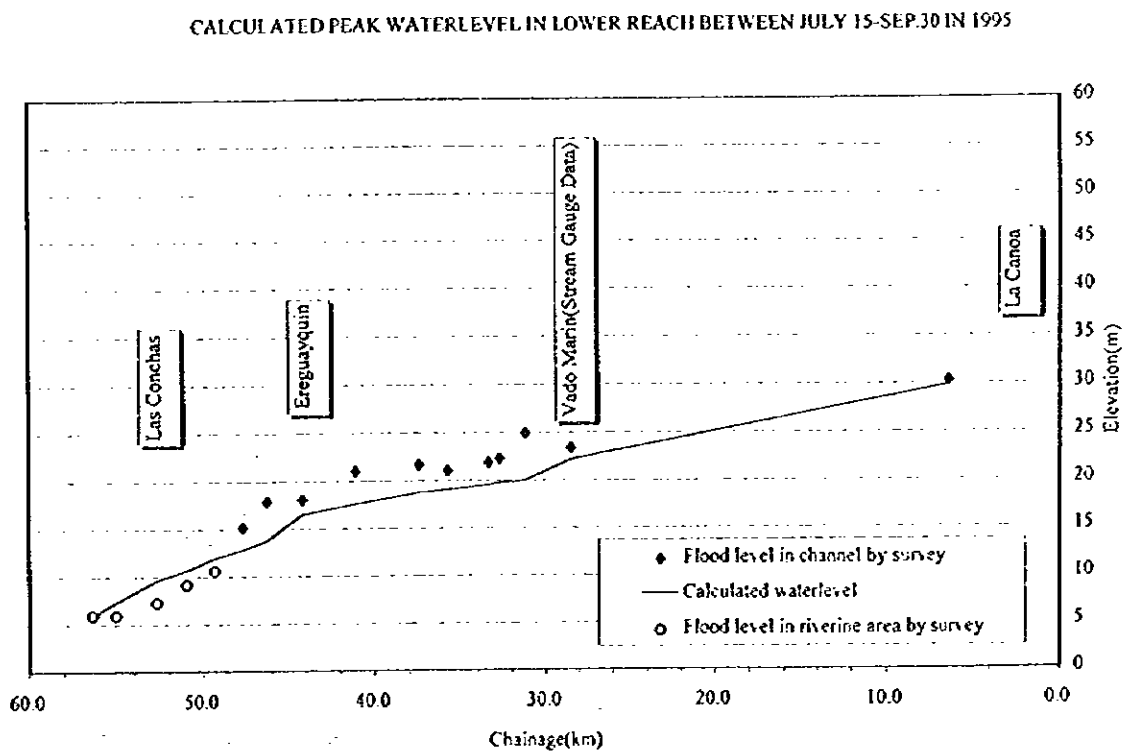
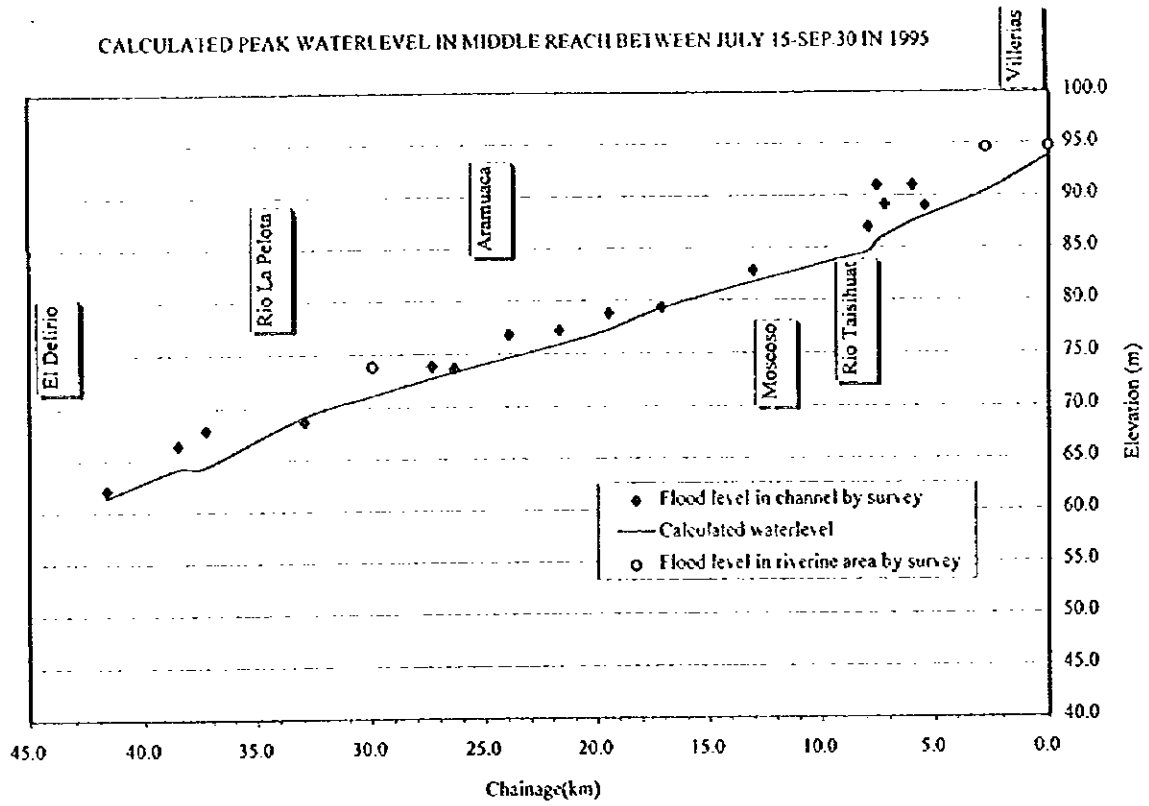
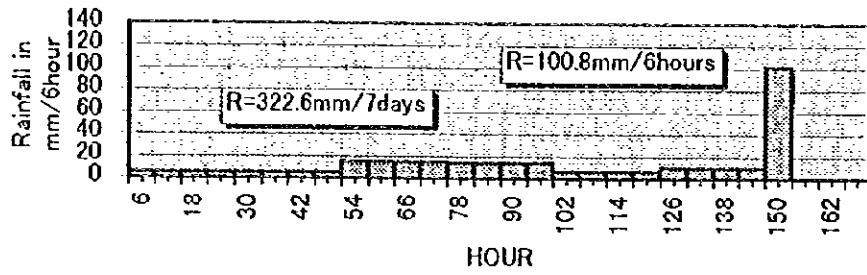
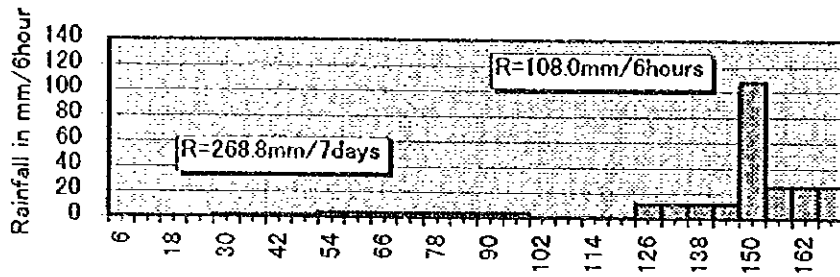


Figure B. 24 CALCULATED WATERLEVEL IN MIDDLE AND LOWER REACH

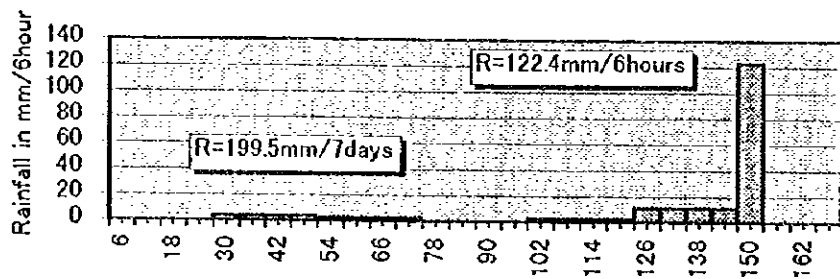
Z2:San Francisco Gotera



M6:El Papalon



U6:Santiago de Maria



U14:Puerto Parada

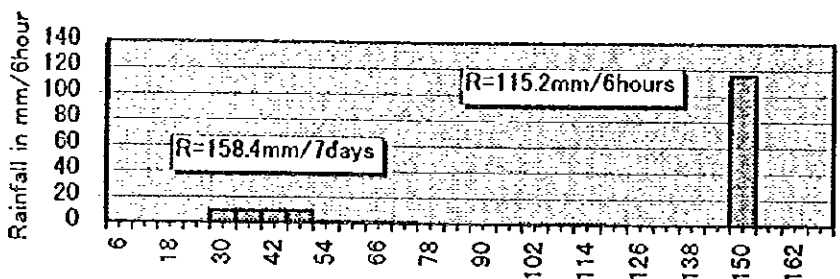


Figure.B.25

DESIGN RAINFALL FOR 10 YEARS RETURN PERIOD

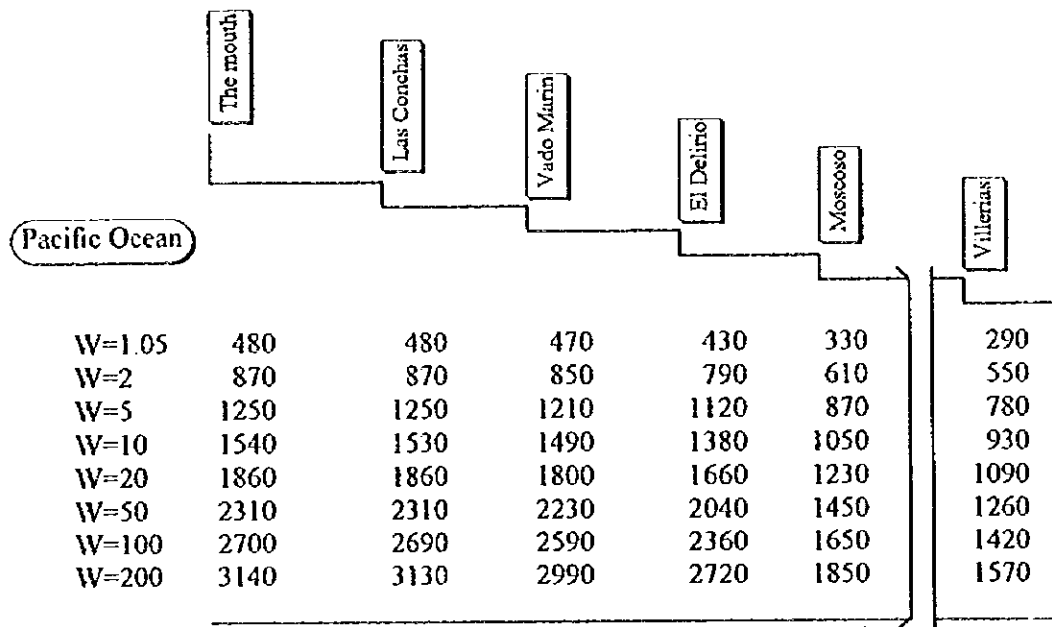


Figure.B.26 DISCHARGE DISTRIBUTION WITHOUT INUNDATION
(unit; m³/s)

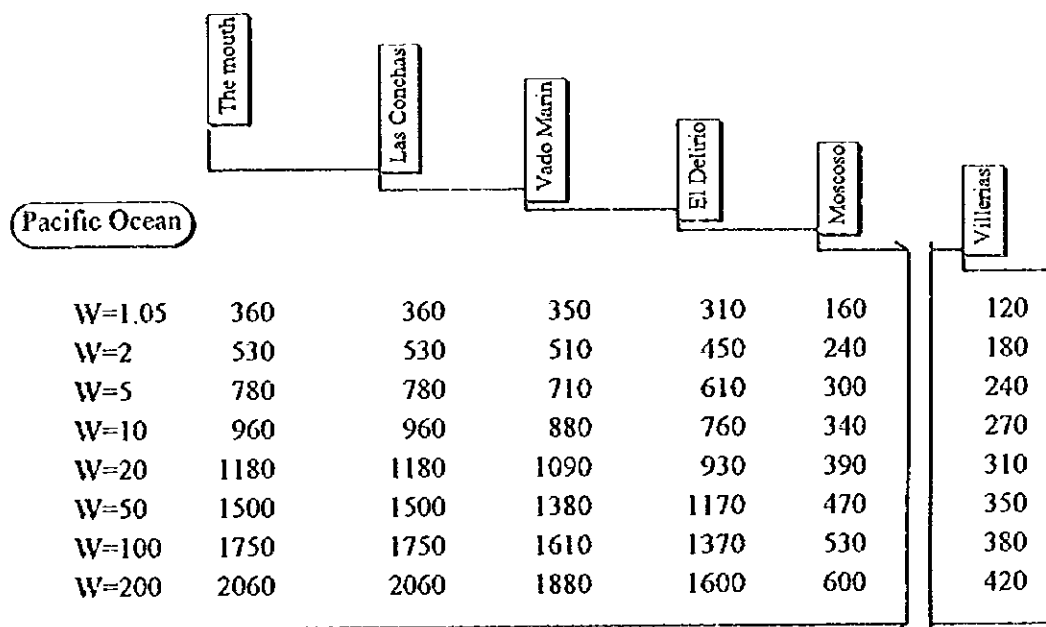


Figure.B.27 DISCHARGE DISTRIBUTION WITH DAM(unit; m³/s)