ANNEX B : TABLES

Table B.2.1 List of Rainfall Gauge Stations in and around the Yuna River Basin

No.	Code	Basin	Name of Station	Class	Location		Elevation	Period of Data Collected			
					Latitude	Longitude	(m)	Year	Mon.	Year	Mon.
1	401	YAQUE D. N.	JARABACOA	1	19° 7' 50"	70° 38' 20"	500	1968	1	1994	4
2	402	YAQUE D. N.	TAVERA	1	19° 17' 0"	70° 43' 5"	300	1968	1	1992	3
3	404	YAQUE D. N.	SANTIAGO ISA	1	19° 26' 45"	70° 44' 45"	160	1967	12	1992	2
4	409	YAQUE D. N.	EL RIO CONSTANZA	2	18° 58' 50"	70° 37' 40"	1120	1960	6	1991	9
5	413	YAQUE D. N.	PINAR QUEMADO	3	19° 5' 30"	70° 40' 30"	565	1968	11	1972	9
6	414	YAQUE D. N.	BOMA	3	19° 10' 14"	70° 39' 46"	435	1974	6	1979	7
7	415	YAQUE D. N.	GUANAJUMA	3	19° 16' 30"	70° 44' 40"	274	1967	5	1970	8
8	416	YAQUE D. N.	PINALITO	3	19° 17' 50"	70° 46' 39"	320	1967	6	1989	6
9	417	YAQUE D. N.	BAO	3	19° 18' 20"	70° 47' 50"	280	1965	12	1970	7
10	418	YAQUE D. N.	SABANA IGLESIA	3	19° 18' 50"	70° 44' 50"	229	1967	8	1970	9
11	419	YAQUE D. N.	LAS CHARCAS	3	19° 24' 30"	70° 42' 50"	170	1967	9	1970	8
12	1001	YASICA	JAMAO	3	19° 37' 50"	70° 27' 0"	32	1968	11	1979	6
13	1002	YASICA	CUESTA BARROSA	1	19° 39' 10"	70° 24' 40"	10	1977	10	1978	10
14	1501	BOBA	LOS JENGIBRES	1	19° 26' 20"	70° 2' 50"	15	1969	10	1992	3
15	1601	NAGUA	CINTA NEGRA	2	19° 16' 26"	69° 58' 1"	180	1981	1	1991	7
16	1603	NAGUA	NAGUA (MET)	3	19° 22' 0"	69° 50' 0"	3	1943	4	1994	5
17	1801	YUNA	SAN FCO. DE MACORIS	1	19° 17' 10"	70° 14' 25"	110	1968	2	1990	9
18	1802	YUNA	JUMA BONAO	1	18° 54' 0"	70° 23' 10"	178	1970	12	1992	1
19	1803	YUNA	LIMON DEL YUNA	1	19° 9' 10"	69° 49' 10"	8	1968	7	1975	1
20	1804	YUNA	LOS QUEMADOS	2	18° 53' 30"	70° 27' 30"	250	1960	6	1992	1
21	1805	YUNA	MAIMON EL PINO	3	18° 53' 50"	70° 17' 30"	98	1960	3	1970	8
22	1806	YUNA	HATILLO YUNA	1	18° 56' 50"	70° 15' 10"	80	1968	1	1971	5
23	1807	YUNA	JIMA RINCON	3	19° 6' 20"	70° 24' 20"	130	1968	5	1975	12
24	1808	YUNA	LOS RANCHITOS	3	19° 11' 10"	70° 24' 30"	56	1968	4	1970	8
25	1809	YUNA	LICEY NARANJAL	3	19° 19' 40"	70° 30' 50"	110	1968	12	1992	2
26	1810	YUNA	LA BIJA	3	19° 9' 0"	70° 7' 45"	28	1968	4	1970	8
27	1811	YUNA	ABADESA	3	19° 0' 50"	69° 55' 30"	33	1960	3	1992	1
28	1813	YUNA	V. ALTAGRACIA (MET)	3	18° 40' 0"	70° 10' 0"	156	1938	8	1980	12
29	1814	YUNA	BARRAQUITO	1	19° 7' 50"	69° 47' 20"	8	1975	2	1992	1
30	1815	YUNA	LA ANGELINA	1	19° 13' 20"	70° 13' 20"	48	1977	1	1992	1
31	1816	YUNA	JOSE CONTRERAS	1	19° 28' 0"	70° 27' 0"	685	1978	11	1992	1
32	1817	YUNA	LOS BOTADOS	1	18° 52' 14"	70° 34' 36"	1020	1980	8	1992	2
33	1821	YUNA	LA CEIBA RIO BLANCO	4	18° 53' 47"	70° 33' 28"	970	1978	3	1992	1
34	1826	YUNA	TIREO EN PINALITO	4	18° 52' 58"	70° 33' 42"	870	1981	4	1991	5
35	1830	YUNA	EL NOVILLO	3	18° 47' 1"	70° 28' 21"	1225	1982	10	1992	3
36	1836	YUNA	EL TALLER - LA VEGA	3	19° 13' 30"	70° 30' 59"	60	1984	5	1990	3
37	1837	YUNA	LA CABILMA	3	18° 59' 3"	70° 2' 56"	46	1983	1	1992	1
38	1838	YUNA	CENOVI SANTA ANA	3	19° 17' 40"	70° 20' 49"	81	1983	2	1992	1
39	1839	YUNA	CEVICOS (MET)	3	19° 0' 0"	69° 58' 0"	90	1938	9	1994	6
40	1840	YUNA	LOS TRES PASOS	3	18° 58' 25"	70° 5' 0"	110	1984	5	1991	9
41	1841	YUNA	TALLER LAS MATAS	3	19° 6' 17"	70° 10' 46"	47	1984	5	1988	4
42	1842	YUNA	PIEDRA BLANCA	3	18° 50' 47"	70° 19' 43"	200	1984	3	1992	1
43	1843	YUNA	EL AGUACATE	3	19° 10' 19"	69° 45' 34"	20	1986	3	1991	5
44	1844	YUNA	VILLA RIVA (MET)	3	19° 10' 0"	69° 54' 0"	17	1939	1	1994	5
45	1845	YUNA	COTUI (MET)	3	19° 3' 0"	70° 9' 0"	60	1938	1	1994	7
46	1846	YUNA	PIMENTEL (MET)	3	19° 11' 0"	70° 6' 0"	37	1931	1	1994	5
47	1847	YUNA	S.F.DE MACORIS (MET)	3	19° 17' 0"	70° 15' 0"	110	1931	7	1994	4
48	1848	YUNA	SALCEDO (MET)	3	19° 22' 0"	70° 25' 0"	196	1931	1	1994	6
49	1849	YUNA	BONAO (MET)	3	18° 56' 0"	70° 24' 0"	172	1938	8	1994	7
50	1850	YUNA	LA VEGA (MET)	3	19° 13' 0"	70° 32' 0"	97	1931	1	1994	5
51	1851	YUNA	MOCA (MET)	3	19° 23' 0"	70° 31' 0"	83	1931	1	1994	7
52	3805	NIZAO	LA ESTRECHURA	3	18° 43' 40"	70° 29' 0"	720	1968	3	1973	2
53	4901	YAQUE D. S.	VALLE NUEVO	5	18° 48' 27"	70° 40' 58"	2300	1968	1	1993	12
54	4902	YAQUE D. S.	CONSTANZA	1	18° 54' 40"	70° 43' 0"	1215	1968	1	1994	2

Table B.2.2 Summary of Rainfall Data

No.	Code	Name of Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	401	JARABACOA	102.2	92.1	100.1	170.0	202.0	84.2	85.8	116.1	106.3	143.2	183.2	138.7	1524.0
2	402	TAVERA	72.7	72.9	74.6	154.0	184.0	74.5	63.6	90.5	103.6	137.5	116.0	103.3	1247.3
3	404	SANTIAGO ISA	52.2	43.7	59.8	133.8	150.1	70.1	43.9	70.3	83.3	108.0	100.8	65.0	981.1
4	409	EL RIO CONSTANZA	76.3	76.7	70.3	117.3	139.5	87.1	91.1	130.7	126.5	138.7	145.5	113.6	1313.4
5	413	PINAR QUEMADO	65.4	139.9	108.6	176.7	254.3	109.4	102.1	170.7	215.0	168.7	220.6	197.4	1928.7
6	414	BOMA	40.9	80.9	100.9	212.9	147.7	82.3	88.1	86.3	69.6	120.2	165.3	140.6	1335.7
7	415	GUANAJUMA	81.2	91.2	61.8	127.6	224.8	120.2	78.7	62.1	77.7	77.8	162.9	197.9	1363.9
8	416	PINALITO	55.7	47.1	34.2	115.5	297.2	140.2	51.6	55.4	39.0	62.7	157.6	223.3	1279.4
9	417	BAO	82.4	73.0	93.4	143.2	225.5	81.6	50.1	58.8	32.2	111.1	132.3	125.0	1208.4
10	418	SABANA IGLESIA	49.6	62.2	31.1	66.4	247.7	94.3	57.5	53.4	50.3	48.6	131.7	122.7	1015.4
11	419	LAS CHARCAS	52.9	50.5	47.7	69.9	214.5	86.8	57.2	32.8	42.7	50.9	193.8	133.8	1033.4
12	1001	JAMAO	126.5	142.5	158.6	249.4	225.1	61.3	70.3	135.3	124.3	188.8	192.6	358.8	2033.6
13	1002	CUESTA BARROSA	419.7	62.6	-	37.1	-	33.6	68.0	75.0	83.0	-	-	-	-
14	1501	LOS JENGIBRES	177.4	134.6	146.9	201.2	273.9	131.8	153.8	180.5	160.3	244.9	316.9	244.6	2366.9
15	1601	CINTA NEGRA	209.4	165.3	139.2	122.1	251.7	169.8	164.6	191.0	202.1	232.4	289.9	252.7	2390.1
16	1603	NAGUA (MET)	156.6	126.8	115.1	149.3	245.4	128.7	136.5	169.0	157.8	210.3	272.6	234.0	2101.8
17	1801	SAN FCO. DE MACORIS	77.9	87.4	68.2	98.7	165.7	119.0	116.1	148.2	124.5	132.7	169.0	121.8	1429.2
18	1802	JUMA BONAO	100.8	105.5	137.2	195.7	283.1	124.6	159.5	178.1	162.9	210.5	247.9	149.3	2055.0
19	1803	LIMON DEL YUNA	72.7	148.8	105.2	128.4	200.2	207.8	186.6	224.5	162.5	229.5	136.5	165.5	1969.0
20	1804	LOS QUEMADOS	118.8	150.9	148.3	256.0	309.1	163.3	187.6	229.5	231.1	247.5	243.4	170.4	2455.9
21	1805	MAIMON EL PINO	80.9	82.8	86.7	164.4	311.7	162.7	180.8	188.0	137.4	125.5	168.0	122.8	1811.6
22	1806	HATILLO YUNA	44.4	157.6	49.5	193.4	550.8	116.3	158.6	209.7	197.2	196.3	225.0	194.6	2293.1
23	1807	JIMA RINCON	39.3	80.4	83.8	105.6	138.4	47.8	61.5	79.5	96.9	95.3	98.3	63.4	990.1
24	1808	LOS RANCHITOS	47.4	45.0	84.7	161.4	243.1	85.1	108.4	139.8	141.6	119.5	273.9	54.3	1504.0
25	1809	LICEY NARANJAL	59.6	80.0	68.9	116.9	178.9	76.2	88.1	103.8	118.5	149.5	153.2	101.2	1294.8
26	1810	LA BIJA	34.7	35.1	28.3	62.1	306.7	120.6	190.1	209.6	199.0	140.4	185.7	119.7	1631.7
27	1811	ABADESA	62.7	57.9	85.0	108.4	233.6	214.2	186.0	230.0	192.9	168.5	117.0	86.0	1742.2
28	1813	V. ALTAGRACIA (MET)	92.5	90.7	93.8	173.7	277.0	270.6	256.7	265.0	237.9	256.1	170.0	105.0	2288.9
29	1814	BARRAQUITO	114.7	97.2	118.0	167.7	314.6	184.9	197.0	209.1	162.4	178.2	192.4	129.5	2065.7
30	1815	LA ANGELINA	79.4	71.9	75.6	147.0	232.4	103.0	138.4	129.9	143.5	150.5	153.8	101.5	1526.9
31	1816	JOSE CONTRERAS	138.5	124.9	123.2	152.4	230.8	110.6	106.5	136.7	133.8	159.3	197.4	136.5	1750.5
32	1817	LOS BOTADOS	209.2	152.0	113.7	155.3	299.4	174.6	217.0	243.6	266.1	295.1	268.0	194.7	2588.8
33	1821	LA CEIBA RIO BLANCO	201.8	155.9	194.5	195.3	333.1	215.2	248.1	314.4	335.8	302.8	334.0	224.4	3055.1
34	1826	TIREO EN PINALITO	274.3	131.4	101.7	141.2	214.7	154.9	108.4	94.9	108.3	193.4	272.9	295.7	2091.7
35	1830	EL NOVILLO	173.9	165.4	183.7	266.1	359.2	153.5	210.1	195.7	250.0	296.4	363.0	206.6	2823.6
36	1836	EL TALLER - LA VEGA	166.4	87.9	77.1	130.8	247.9	93.7	100.5	134.1	191.7	172.6	184.0	164.4	1751.2
37	1837	LA CABILMA	99.7	108.3	78.4	102.2	224.3	132.1	185.0	211.6	175.5	193.7	164.9	107.9	1783.7
38	1838	CENOVI SANTA ANA	171.3	135.4	161.3	219.5	169.4	221.1	172.5	208.5	229.0	223.8	382.2	154.9	2448.8
39	1839	CEVICOS (MET)	84.3	84.9	94.6	148.8	326.4	231.0	233.4	234.3	194.7	175.0	137.2	106.4	2051.0
40	1840	LOS TRES PASOS	59.3	253.3	69.0	31.8	132.7	78.6	73.5	104.3	103.3	57.6	69.4	63.5	1096.3
41	1841	TALLER LAS MATAS	72.3	66.5	93.5	93.4	265.5	137.1	91.2	40.7	227.6	238.2	180.3	81.8	1587.8
42	1842	PIEDRA BLANCA	133.0	125.0	129.0	190.5	230.1	169.4	143.4	206.8	226.2	223.6	233.2	126.1	2136.5
43	1843	EL AGUACATE	197.2	117.7	26.3	122.1	200.2	212.1	225.8	234.4	283.4	142.2	208.4	243.7	2213.4
44	1844	VILLA RIVA (MET)	135.8	116.5	116.5	142.4	265.1	232.4	212.3	228.5	213.7	182.8	213.9	184.6	2244.4
45	1845	COTUI (MET)	87.3	90.6	88.9	132.5	234.6	144.7	178.2	181.3	151.5	142.8	149.0	127.5	1708.9
46	1846	PIMENTEL (MET)	100.8	84.7	81.7	114.3	255.0	167.6	172.3	174.4	138.5	148.0	176.1	156.5	1769.8
47	1847	S.F.DE MACORIS (MET)	91.2	83.8	65.9	91.4	202.9	119.5	122.4	145.5	111.8	123.2	143.6	128.3	1429.6
48	1848	SALCEDO (MET)	80.0	68.6	70.4	97.4	166.0	86.4	102.3	109.9	97.7	118.2	134.0	122.8	1253.7
49	1849	BONAO (MET)	122.0	110.9	125.7	216.3	318.8	157.5	174.9	194.7	183.5	227.0	221.6	143.5	2196.3
50	1850	LA VEGA (MET)	84.2	77.7	86.8	132.9	204.1	91.7	101.3	101.9	116.1	139.5	135.4	111.1	1382.8
51	1851	MOCA (MET)	76.8	68.6	59.2	93.5	170.0	78.2	92.9	87.6	99.5	131.7	125.1	110.5	1193.6
52	3805	LA ESTRECHURA	49.4	82.1	67.6	104.6	184.0	116.8	163.7	182.2	134.1	149.5	161.8	138.2	1534.0
53	4901	VALLE NUEVO	59.7	40.6	42.7	65.7	92.0	117.6	70.9	117.7	118.7	89.0	83.7	55.7	954.0
54	4902	CONSTANZA	24.2	27.8	58.1	76.8	170.2	79.3	56.8	113.1	115.8	82.5	81.6	61.4	947.6

Table B.2.3 List of Meteorological Stations in and around the Yuna River Basin

No.	Code	Basin	Name of Station	Class	Location		Elevation	Period of Data Collected					
					Latitude	Longitude	(m)	Year	Month	Day	Year	Month	Day
1	401	YAQUE DEL NORTE	JARABACOA	1	19 ° 7 ' 50 "	70 ° 38 ' 20 "	500	1967	9	1	1988	10	2
2	402	YAQUE DEL NORTE	TAVERA	1	19 ° 17 ' 0 "	70 ° 43 ' 5 "	300	1967	9	1	1988	9	1
3	404	YAQUE DEL NORTE	SANTIAGO-ISA	1	19 ° 26 ' 45 "	70 ° 44 ' 45 "	160	1967	9	1	1988	10	1
4	1801	YUNA	SAN FCO. DE MACORIS	1	19 ° 17 ' 10 "	70 ° 14 ' 25 "	110	1968	2	1	1988	9	2
5	1802	YUNA	JUMA-BONAO	1	18 ° 54 ' 0 "	70 ° 23 ' 10 "	178	1971	1	2	1988	9	1
6	1803	YUNA	EL LIMON	1	19 ° 9 ' 10 "	69 ° 49 ' 10 "	8	1968	7	1	1976	12	31
7	1806	YUNA	HATILLO - YUNA	1	18 ° 56 ' 50 "	70 ° 15 ' 10 "	80	1968	1	1	1971	4	30
8	1814	YUNA	BARRAQUITO	1	19 ° 7 ' 50 "	69 ° 47 ' 20 "	8	1975	1	1	1988	9	1
9	1815	YUNA	LA ANGELINA	1	19 ° 13 ' 20 "	70 ° 13 ' 20 "	48	1973	2	1	1988	9	1
10	1816	YUNA	JOSE CONTRERAS	1	19 ° 28 ' 0 "	70 ° 27 ' 0 "	685	1978	10	1	1988	4	1
11	1817	YUNA	LOS BOTADOS	1	18 ° 52 ' 14 "	70 ° 34 ' 36 "	1020	1980	8	1	1988	9	1
12	1830	YUNA	EL NOVILLO	1	18 ° 47 ' 1 "	70 ° 28 ' 21 "	1225	1982	10	1	1988	7	1
13	1843	YUNA	EL AGUACATE	1	19 ° 10 ' 19 "	69 ° 45 ' 34 "	20	1986	1	1	1988	3	1
14	4901	YAQUE DEL SUR	VALLE NUEVO	1	18 ° 48 ' 27 "	70 ° 40 ' 58 "	2300	1967	9	1	1972	12	31
15	4902	YAQUE DEL SUR	CONSTANZA	1	18 ° 54 ' 40 "	70 ° 43 ' 0 "	1215	1967	8	1	1979	6	30

Table B.2.4 Summary of Meteorological Data (1/2)

(1) Temperature (°C)

No.	Code	Name of Station	Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	401	JARABACOA	Mean	19.7	20.1	21.1	22.1	23.0	23.7	23.7	23.8	23.6	23.2	21.8	20.1	22.2
			Max.	28.6	29.2	29.9	31.3	31.4	32.3	32 2	32.2	32.4	31.4	29.9	28.5	30.8
			Min.	10.1	10.4	11.4	12.3	14.3	14.8	14.3	14.2	14.3	14.1	12.3	10.9	12.8
2	402	TAVERA	Mean	22.3	22.5	23.3	23.9	24.5	25.3	25.8	25.9	25.8	25.3	24.1	22.7	24.3
			Max.	30.8	30.8	31.7	31.8	31.6	32.5	33.3	32.9	33.4	32.5	31.4	30.0	31.9
			Min.	14.7	14.1	15.4	16.2	17.7	18.4	18.7	18.6	18.5	18.1	16.9	15.0	16.9
3	404	SANTIAGO-ISA	Mean	23.3	23.5	24.4	25.3	26.2	27.3	27.6	27.6	27.4	26.6	25.1	23.4	25.6
			Max.	31.2	32.1	33.3	33.8	33.9	34.9	35.3	35.2	35.0	34.4	32.7	31.1	33.6
			Min.	14.7	14.6	15.2	16.0	17.7	19.7	19.3	20.3	19.5	19.0	16.8	15.0	17.3
4	1801	SAN FCO. DE MACORIS	Mean	23.0	23.1	23.9	24.9	25.9	26.5	26.5	26.5	26.5	26.1	25.0	23.3	25.1
			Max.	30.6	31.5	32.9	33.1	33.8	33.7	33.5	33.7	33.8	33.5	32.5	31.0	32.8
			Min.	14.5	14.3	14.3	15.5	17.7	19.3	19.6	19.2	19.1	18.6	17.0	14.6	17.0
5	1802	JUMA-BONAO	Mean	22.5	22.6	23.5	24.5	24.9	25.7	26.1	26.0	25.9	25.6	24.5	23.2	24.6
			Max.	31.0	30.7	31.9	32.3	32.7	33.2	33.9	33.7	33.8	33.5	32.4	31.4	32.5
			Min.	13.5	13.2	14.1	15.4	16.9	17.7	18.5	18.5	17.7	17.5	16.0	14.1	16.1
6	1803	EL LIMON	Mean	23.7	23.9	24.4	24.8	25.9	26.9	26.8	26.4	26.8	26.4	25.2	24.0	25.4
			Max.	31.0	31.5	32.6	32.8	32.8	33.8	33.5	32.8	34.0	33.8	32.3	31.2	32.7
			Min.	16.6	16.3	16.2	16.7	18.7	20.0	20.5	20.5	20.3	19.7	17.8	16.8	18.3
7	1806	HATILLO - YUNA	Mean	23.6	23.5	24.6	25.7	26.8	26.8	26.7	26.7	26.6	26.6	25.2	24.1	25.6
			Max.	33.0	32.3	34.0	35.0	34.5	34.0	35.0	34.5	34.5	34.5	34.0	33.0	34.0
			Min.	15.0	15.3	15.7	17.0	16.5	19.0	19.5	18.5	19.0	18.0	16.0	15.5	17.1
8	1814	BARRAQUITO	Mean	23.6	23.6	24.2	25.4	26.1	26.9	26.9	26.9	27.0	26.5	25.5	24.1	25.6
			Max.	31.2	31.7	32.1	32.8	33.1	33.5	33.4	33.3	34.0	33.3	32.5	31.6	32.7
			Min.	15.6	15.1	15.8	17.2	19.1	20.7	20.8	20.9	20.5	20.1	18.3	16.6	18.4
9	1815	LA ANGELINA	Mean	23.7	24.0	24.5	25.5	26.3	27.1	27.1	27.2	27.2	26.8	25.6	24.2	25.8
			Max.	31.5	32.2	33.1	33.7	33.7	38.1	34.2	34.0	34.5	34.0	32.8	32.0	33.7
			Min.	16.1	15.3	15.4	17.0	17.8	19.8	20.0	19.3	19.2	19.1	16.6	15.7	17.6
10	1816	JOSE CONTRERAS	Mean	20.6	20.6	21.2	21.8	22.1	23.6	23.7	23.9	24.1	23.9	22.6	21.0	22.4
			Max.	26.7	27.8	28.4	28.8	28.9	33.4	29.9	29.7	31.3	29.4	29.0	28.2	29.3
			Min.	13.7	13.9	14.1	14.9	16.1	16.8	18.0	17.9	17.8	17.4	16.0	14.3	15.9
11	1817	LOS BOTADOS	Mean	18.9	19.1	19.7	19.9	20.5	21.1	21.1	20.8	20.9	20.6	20.1	19.3	20.2
			Max.	28.9	28.7	29.8	30.1	29.5	30.5	34.0	30.6	30.2	29.8	29.6	29.0	30.0
			Min.	8.1	8.7	8.0	8.7	10.6	11.8	12.0	11.8	11.6	11.5	10.6	8.4	10.2
12	1830	EL NOVILLO	Mean	18.4	19.0	19.0	19.4	20.0	20.9	21.0	20.6	20.4	20.2	19.4	19.3	19.8
			Max.	24.8	24.2	26.1	26.0	27.1	27.7	27.4	26.9	26.8	25.7	25.4	25.9	26.1
			Min.	12.0	12.8	12.3	11.5	13.1	14.0	14.3	14.7	14.6	12.7	12.1	12.9	13.1
13	1843	EL AGUACATE	Mean	23.9	24.9	26.1	26.3	25.2	25.7	25.7	26.4	25.6	-	-	-	-
			Max.	29.8	30.0	31.5	31.7	31.5	32.5	31.3	32.0	32.5	28.0	30.0	30.5	30.9
			Min.	16.3	16.8	18.7	14.0	20.3	19.5	19.8	20.3	20.0	19.5	19.5	18.5	18.6
14	4901	VALLE NUEVO	Mean	5.8	5.7	6.5	6.1	9.5	9.6	9.0	9.5	10.8	9.2	8.6	6.2	8.0
			Max.	12.2	12.8	12.8	12.3	16.0	15.8	15.0	16.5	16.6	16.4	15.8	14.5	14.7
			Min.	0.3	0.1	0.8	1.0	3.0	5.1	4.5	4.0	4.2	3.6	1.5	0.0	2.3
15	4902	CONSTANZA	Mean	16.3	16.7	17.6	18.3	19.3	19.7	19.9	19.7	19.6	19.5	19.1	16.9	18.5
			Max.	25.2	25.9	27.4	27.5	28.3	46.3	28.9	28.6	27.9	27.9	28.1	25.9	29.0
			Min.	4.6	4.5	6.1	6.9	10.1	10.9	9.4	9.9	10.5	10.0	8.1	6.5	8.1

Table B.2.4 Summary of Meteorological Data (2/2)

(2) Relative Humidity (%)

No.	Code	Name of Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	401	JARABACOA	84.4	83.1	81.2	81.4	82.4	79.8	78.9	79.5	80.9	83.2	85.6	85.8	82.2
2	402	TAVERA	80.2	75.9	72.4	75.2	79.2	76.9	74.1	74.2	75.2	77.0	78.9	79.6	76.6
3	404	SANTIAGO-ISA	77.1	75.3	72.6	73.5	75.3	73.8	72.2	72.4	74.3	75.2	79.5	79.5	75.1
4	1801	SAN FCO. DE MACORIS	80.1	76.7	75.6	75.8	77.4	77.0	78.6	79.0	78.8	80.1	82.5	83.5	78.8
5	1802	JUMA-BONAO	83.8	83.3	80.9	81.1	80.1	81.2	81.1	82.9	82.0	84.5	85.3	85.4	82.6
6	1803	EL LIMON	88.0	85.5	-	79.9	80.6	81.9	84.0	88.0	87.4	86.6	88.2	91.0	-
7	1806	HATILLO - YUNA	-	-	-	-	-	-	-	-	-	-	-	-	-
8	1814	BARRAQUITO	83.6	83.3	80.4	79.4	82.5	76.8	83.7	83.7	83.8	84.4	85.2	84.8	82.6
9	1815	LA ANGELINA	84.4	81.3	80.5	80.6	82.2	80.7	82.1	82.7	82.6	83.6	84.9	86.0	82.6
10	1816	JOSE CONTRERAS	86.6	86.8	86.2	85.2	87.1	83.7	82.4	83.1	84.3	85.0	86.9	86.8	85.3
11	1817	LOS BOTADOS	70.6	72.2	73.6	81.3	76.0	75.2	76.6	96.1	79.1	86.7	77.7	68.6	77.8
12	1830	EL NOVILLO	93.1	92.0	89.1	87.1	86.3	87.1	85.6	87.3	86.9	86.8	88.3	90.0	88.3
13	1843	EL AGUACATE	88.4	88.6	87.2	86.2	84.6	85.1	85.0	84.9	86.0	84.5	85.9	91.8	86.5
14	4901	VALLE NUEVO	-	-	-	-	-	-	-	-	-	-	-	-	-
15	4902	CONSTANZA	81.9	78.2	76.2	76.3	76.7	76.1	71.1	75.0	76.9	79.0	79.1	78.8	77.1

(3) Evaporation (mm)

No.	Code	Name of Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	401	JARABACOA	83	78	118	110	129	130	147	132	120	111	82	76	1317
2	402	TAVERA	116	135	177	171	169	181	209	206	172	153	119	102	1910
3	404	SANTIAGO-ISA	130	131	208	198	203	230	219	211	233	175	134	128	2199
4	1801	SAN FCO. DE MACORIS	93	100	143	151	146	166	157	139	137	127	84	87	1532
5	1802	JUMA-BONAO	101	125	165	147	186	172	178	173	155	143	110	103	1756
6	1803	EL LIMON	101	102	131	148	150	114	125	127	115	91	96	-	-
7	1806	HATILLO - YUNA	-	117	148	-	-	-	-	-	-	-	-	-	-
8	1814	BARRAQUITO	91	101	130	133	160	140	150	142	127	113	92	78	1457
9	1815	LA ANGELINA	116	131	169	183	173	176	169	202	177	158	121	100	1877
10	1816	JOSE CONTRERAS	88	117	142	148	127	164	174	143	137	134	111	119	1606
11	1817	LOS BOTADOS	120	108	129	129	129	148	-	126	123	-	-	150	-
12	1830	EL NOVILLO	141	176	166	164	181	185	173	173	172	154	156	149	1989
13	1843	EL AGUACATE	-	-	-	-	-	-	-	-	-	-	-	-	-
14	4901	VALLE NUEVO	121	-	-	-	-	-	-	149	-	-	-	119	-
15	4902	CONSTANZA	92	74	102	91	96	103	124	107	138	127	103	123	1279

(4) Wind Velocity (m/s)

No.	Code	Name of Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
8	1814	BARRAQUITO	1.4	1.4	1.5	1.7	1.3	1.2	1.1	1.0	1.2	1.1	1.0	1.1	1.3

Table B.2.5 List of Hydrological Stations in the Yuna River Basin

No	Code	Name of Station	Class	Location		Elevation (m)	Catchment Area (km2)	Period of Data Collected					
				Latitude	Longitude			Year	Month	Day	Year	Month	Day
1	180001	LOS QUEMADOS	1	18° 53 ' 30 "	70° 27 ' 30 "	250	363	1962	4	1	1984	8	7
2	180002	HATILLO	1	18° 56 ' 50 "	70° 15 ' 10 "	76	1071	1955	1	1	1970	11	30
3	180003	VILLA RIVA	4	19° 10 ' 10 "	69° 54 ' 20 "	10	4680	1956	1	1	1988	12	31
4	180004	EL LIMON	1	19° 9 ' 10 "	69° 49 ' 9 "	8	5130	1968	1	5	1988	12	31
5	180007	LOS PLATANOS	1	18° 59 ' 25 "	70° 13 ' 50 "	65	1167	1971	4	15	1982	4	30
6	180011	PIEDRA LOS VEGANOS	4	18° 49 ' 11 "	70° 28 ' 19 "	470	64	1982	12	20	1990	12	31
7	181001	EL TORITO	4	18° 45 ' 22 "	70° 27 ' 21 "	760	14	1982	1	1	1988	12	31
8	181101	LOS ARROCES	4	18° 58 ' 40 "	70° 27 ' 10 "	218	78	1983	8	1	1988	12	31
9	182001	LOS GUAZAROS	4	18° 51 ' 20 "	70° 31 ' 35 "	630	21	1978	12	7	1988	12	31
10	182101	EL MECHE	4	18° 51 ' 17 "	70° 31 ' 35 "	700	3	1980	1	1	1988	12	31
11	182201	ARROYON ARRIBA	4	18° 51 ' 39 "	70° 31 ' 42 "	700	8	1980	1	1	1986	7	31
12	182202	ARROYON ABAJO	4	18° 51 ' 41 "	70° 31 ' 23 "	600	10	1979	11	1	1987	11	17
13	183001	BLANCO	2	18° 52 ' 58 "	70° 31 ' 17 "	465	191	1977	11	1	1988	9	14
14	183101	PINALITO	4	18° 55 ' 8 "	70° 37 ' 58 "	1165	58	1981	1	21	1988	12	31
15	183102	TIREO	4	18° 53 ' 3 "	70° 34 ' 6 "	660	134	1980	1	1	1988	12	31
16	183201	BLANCO	4	18° 53 ' 14 "	70° 33 ' 29 "	630	3	1980	1	1	1988	12	31
17	184001	MAIMON	1	18° 53 ' 47 "	70° 17 ' 21 "	96	134	1968	1	1	1988	12	31
18	185001	BAYACANES	2	19° 13 ' 52 "	70° 35 ' 12 "	130	143	1961	4	1	1990	12	31
19	185002	RANCHITO	4	19° 11 ' 10 "	71° 24 ' 30 "	56	1160	1968	2	16	1981	4	30
20	185003	LA BIJA	1	19° 9 ' 0 "	70° 7 ' 45 "	28	2335	1968	1	1	1991	6	30
21	185101	NARANJAL	4	19° 19 ' 47 "	70° 30 ' 51 "	96	333	1964	1	1	1987	11	30
22	185201	RINCON	1	19° 6 ' 20 "	70° 24 ' 20 "	80	159	1957	9	1	1976	10	14
23	185502	SANTA ANA	4	19° 17 ' 40 "	70° 20 ' 49 "	81	94	1982	1	1	1988	12	31
24	185602	LA BOCA	4	19° 14 ' 44 "	70° 18 ' 9 "	61	165	1982	1	5	1988	12	31
25	187002	ABADESA II	2	19° 1 ' 0 "	69° 55 ' 36 "	33	219	1971	1	1	1988	12	31
26	188002	LOS TRES PASOS	2	18° 56 ' 47 "	70° 4 ' 31 "	77	79	1984	5	1	1990	12	31

Table B.2.6 Summary of River Discharge Data (1/2)

No.	Code	Name of Station	Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	180001	LOS QUEMADOS	Mean	15.49	17.42	13.65	20.29	24.27	16.01	13.05	16.70	18.60	20.24	21.36	24.37	18.46
			Max.	40.28	87.16	81.38	86.16	107.66	70.62	56.85	139.12	83.69	109.32	109.06	94.24	88.79
			Min.	9.93	8.95	6.26	8.69	12.03	8.76	7.24	7.31	9.95	10.16	10.98	11.41	9.31
2	180002	HATILLO	Mean	28.06	25.25	18.75	28.96	45.24	33.11	24.97	28.26	24.10	33.98	44.87	41.15	31.39
			Max.	64.02	68.19	49.06	84.87	123.30	75.13	61.20	94.32	56.61	101.44	126.44	112.60	84.77
			Min.	17.72	15.58	11.99	13.16	21.84	20.71	14.91	14.99	14.93	17.63	21.54	20.00	17.08
3	180003	VILLA RIVA	Mean	71.58	74.35	56.30	80.25	155.52	116.23	74.42	84.06	60.64	88.84	127.25	100.83	90.86
			Max.	186.65	205.33	186.93	242.85	411.68	329.52	171.06	260.95	236.98	275.26	370.66	327.30	267.10
			Min.	39.69	34.36	24.82	26.31	48.92	47.23	38.14	32.43	32.60	38.16	46.74	46.69	38.01
4	180004	EL LIMON	Mean	80.57	90.04	65.53	75.09	142.60	104.34	67.77	84.50	88.72	99.69	130.21	113.45	95.21
			Max.	195.04	230.75	172.19	228.58	348.89	240.07	151.31	246.09	232.97	258.40	307.69	282.81	241.23
			Min.	45.37	43.41	30.53	30.30	49.82	47.52	34.81	38.09	44.01	47.64	55.14	54.18	43.40
5	180007	LOS PLATANOS	Mean	28.86	27.99	29.68	33.44	46.78	34.36	25.11	37.46	39.41	40.76	49.46	44.35	36.47
			Max.	96.19	116.27	143.95	207.26	257.69	208.05	120.94	392.87	222.67	252.62	212.49	180.49	200.96
			Min.	18.32	14.91	14.37	13.73	17.72	16.22	14.51	17.78	18.42	18.22	24.03	21.52	17.48
6	180011	PIEDRA LOS VEGANOS	Mean	4.70	4.27	4.14	4.12	5.14	4.63	2.90	3.93	4.63	4.61	5.90	4.35	4.44
			Max.	21.63	18.87	16.21	20.71	33.62	18.99	17.31	28.82	66.46	24.10	38.40	16.52	26.80
			Min.	2.50	2.34	2.36	2.21	1.90	2.40	1.85	1.93	1.96	2.22	2.35	3.16	2.26
7	181001	EL TORITO	Mean	0.95	1.39	0.62	1.14	1.23	1.05	0.64	0.55	1.77	0.97	1.45	1.66	1.12
			Max.	2.18	74.95	3.48	3.50	6.26	6.81	1.28	3.82	68.65	6.74	13.14	20.80	17.63
			Min.	0.56	0.49	0.51	0.83	0.56	0.52	0.48	0.35	0.30	0.42	0.73	0.58	0.53
8	181101	LOS ARROCES	Mean	5.80	7.27	6.10	4.92	6.43	5.23	5.18	5.70	8.05	6.04	10.10	5.47	6.36
			Max.	19.49	16.57	11.26	8.29	14.31	14.10	6.78	28.56	34.15	7.63	32.45	8.80	16.87
			Min.	3.61	4.26	3.89	3.33	3.49	3.35	3.66	3.29	3.21	4.69	5.68	3.92	3.86
9	182001	LOS GUAZAROS	Mean	2.41	2.41	2.52	2.74	3.33	3.47	2.02	1.86	2.27	3.00	4.20	2.80	2.75
			Max.	10.62	9.68	11.48	12.58	13.60	14.40	13.50	17.96	17.50	10.80	20.09	11.29	13.63
			Min.	0.90	0.98	1.04	1.22	1.38	1.47	0.97	0.67	0.89	1.38	1.58	1.27	1.15
10	182101	EL MECHE	Mean	0.25	0.28	0.19	0.27	0.43	0.28	0.21	0.32	0.40	0.43	0.46	0.27	0.32
			Max.	0.86	1.03	0.82	1.02	2.14	0.92	1.56	3.00	1.82	1.89	1.92	1.05	1.50
			Min.	0.11	0.08	0.07	0.10	0.16	0.11	0.08	0.09	0.15	0.18	0.21	0.13	0.12
11	182201	ARROYON ARRIBA	Mean	0.57	0.80	0.42	0.56	1.06	1.11	0.37	0.56	0.50	0.83	0.80	0.44	0.67
			Max.	1.56	3.48	1.57	1.72	5.77	3.91	1.77	3.38	3.43	2.15	5.46	0.77	2.91
			Min.	0.34	0.29	0.12	0.31	0.32	0.60	0.23	0.30	0.21	0.35	0.35	0.33	0.31
12	182202	ARROYON ABAJO	Mean	0.74	0.84	0.54	0.71	1.45	1.39	1.15	1.52	1.30	1.71	1.04	1.08	1.12
			Max.	2.56	3.44	2.45	2.48	6.32	3.91	4.84	7.75	6.00	5.79	2.73	2.86	4.26
			Min.	0.37	0.36	0.33	0.32	0.50	0.83	0.77	0.81	0.61	0.87	0.50	0.47	0.56
13	183001	BLANCO	Mean	5.27	4.81	3.63	4.45	7.03	6.78	5.28	5.73	5.84	6.60	7.79	6.30	5.79
			Max.	15.68	10.83	8.15	12.58	20.55	18.67	17.28	24.24	28.37	17.91	26.46	15.48	18.02
			Min.	3.34	4.60	2.82	2.87	3.76	4.03	3.54	3.31	3.50	4.42	4.59	3.97	3.73

Table B.2.6 Summary of River Discharge Data (2/2)

No.	Code	Name of Station	Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
14	183101	PINALITO	Mean	0.61	0.52	0.30	0.46	1.19	1.26	0.50	0.57	1.42	1.15	1.03	0.56	0.80
			Max.	6.04	2.93	1.53	9.32	12.46	17.26	3.59	7.30	14.25	12.24	7.56	4.89	8.28
			Min.	0.19	0.15	0.14	0.14	0.27	0.14	0.14	0.12	0.18	0.26	0.29	0.21	0.19
15	183102	TIREO	Mean	4.56	4.09	3.12	3.19	4.61	3.37	2.66	3.00	4.28	4.10	5.46	4.71	3.93
			Max.	17.58	12.18	6.71	6.71	15.67	7.94	4.78	21.59	20.23	11.65	24.56	14.73	13.69
			Min.	2.70	2.81	2.33	3.37	2.65	2.44	2.29	2.20	2.27	2.68	3.11	3.12	2.66
16	183201	BLANCO	Mean	0.27	0.20	0.13	0.13	0.17	0.15	0.11	0.18	0.19	0.30	0.16	0.16	0.18
			Max.	0.41	0.47	0.20	0.36	0.36	0.28	0.22	0.81	0.83	0.96	0.38	0.47	0.48
			Min.	0.21	0.10	0.10	0.10	0.10	0.10	0.07	0.09	0.10	0.13	0.22	0.23	0.13
17	184001	MAIMON	Mean	3.51	4.48	3.22	3.95	7.50	4.45	3.35	5.62	6.53	4.44	5.31	4.89	4.77
			Max.	16.73	33.69	18.15	31.59	110.08	37.94	32.86	92.76	53.38	65.06	51.13	28.97	47.70
			Min.	2.06	2.03	1.70	1.71	2.14	1.84	1.62	1.66	2.27	1.73	2.09	2.31	1.93
18	185001	BAYACANES	Mean	3.51	3.87	3.66	4.89	7.14	3.84	2.73	3.29	2.98	4.10	5.10	5.81	4.24
			Max.	29.33	36.96	53.59	64.05	108.66	47.89	23.90	46.02	47.30	64.77	64.11	53.88	53.37
			Min.	1.52	1.42	1.16	1.33	1.87	1.81	1.46	1.49	1.33	1.44	1.65	1.87	1.53
19	185002	RANCHITO	Mean	8.48	9.72	8.98	15.03	21.06	9.20	4.85	6.10	8.67	9.97	15.57	12.77	10.87
			Max.	39.00	47.97	61.56	85.59	97.57	42.17	20.33	51.36	55.53	67.69	79.49	76.06	60.36
			Min.	3.07	2.52	1.76	2.44	4.34	2.90	1.22	1.20	1.62	1.63	3.30	2.44	2.37
20	185003	LA BIJA	Mean	33.36	37.66	29.14	37.74	69.74	36.90	26.05	29.19	28.59	34.70	52.60	43.11	38.23
			Max.	105.57	124.57	98.08	143.04	211.46	123.58	74.11	110.37	124.15	126.69	178.60	142.67	130.24
			Min.	18.71	17.87	14.54	14.40	22.45	17.65	13.97	13.76	17.58	15.75	20.10	20.44	17.27
21	185101	NARANJAL	Mean	1.04	1.31	1.24	1.84	3.97	1.33	0.85	0.91	1.35	1.40	2.33	1.76	1.61
			Max.	2.38	9.28	17.18	28.14	40.22	10.68	6.64	6.04	15.73	13.67	16.52	20.71	15.60
			Min.	0.74	0.68	0.60	0.58	0.72	1.08	0.67	0.61	0.61	0.61	0.69	0.90	0.71
22	185201	RINCON	Mean	11.35	9.43	7.68	9.28	14.75	9.28	7.63	7.70	8.62	9.89	12.71	13.98	10.19
			Max.	44.28	75.92	35.09	75.00	71.35	30.14	27.22	58.88	49.56	63.52	77.07	65.08	56.09
			Min.	5.92	5.04	4.46	4.45	6.68	5.58	4.89	4.61	4.98	5.75	6.30	6.48	5.43
23	185502	SANTA ANA	Mean	1.33	1.02	0.82	1.07	1.50	0.75	0.51	0.54	0.80	1.62	2.40	0.93	1.11
			Max.	5.75	5.21	3.54	9.92	10.51	4.51	2.66	2.81	4.23	12.98	14.96	2.50	6.63
			Min.	0.52	0.66	0.44	0.33	0.30	0.27	0.27	0.18	0.27	0.34	0.43	0.48	0.37
24	185602	LA BOCA	Mean	2.05	1.72	1.22	0.87	2.59	1.26	0.71	0.90	1.34	1.31	4.52	2.93	1.79
			Max.	18.59	11.34	8.30	10.18	26.35	15.41	5.13	7.87	14.23	14.34	38.40	20.22	15.86
			Min.	0.41	0.62	0.41	0.33	0.29	0.34	0.27	0.17	0.20	0.14	0.55	0.66	0.37
25	187002	ABADESA II	Mean	2.46	2.61	2.82	3.66	9.22	10.79	7.40	10.57	10.81	8.76	6.84	3.99	6.66
			Max.	12.96	18.54	30.24	46.64	72.10	95.84	83.47	100.86	117.87	102.28	72.85	31.36	65.42
			Min.	1.58	1.38	1.17	1.08	1.70	2.81	2.55	2.75	3.11	2.95	2.50	1.97	2.13
26	188002	LOS TRES PASOS	Mean	1.05	1.91	1.09	1.13	1.31	1.04	1.31	2.20	5.14	2.20	1.24	2.07	1.81
			Max.	3.96	36.64	5.27	14.92	80.46	21.47	10.69	67.39	209.22	52.83	19.53	29.95	46.03
			Min.	0.49	0.49	0.57	0.34	0.28	0.44	0.38	0.43	0.49	0.68	0.35	0.59	0.46

Table B.2.7 Summary of Spring Discharge Data

No.	Name of Spring	Period of Data Collected	Number of Data
1	Guaraguao Main Canal	10/1/75 - 18/7/94	110
2	Guaraguao Second Canal	17/2/76 - 12/11/91	14
3	Cercado	17/2/76 - 25/4/76	10
4	Laguna Cristal	27/3/76 - 25/4/76	5

Table B.2.8 Summary of Suspended Sediment Data

No.	Station Code	Name of Station	Period of Data Collected	Number of Data
1	180003	Villa Riva	8/4/80 - 26/3/84	18
2	180004	El Limon	20/1/80 - 25/3/84	25
3	187002	Abadesa	23/5/78 - 20/11/85	35

Table B.2.9 List of Discharge Measurement Sites in the Study Area

No.	Location	Code	Remark
1	Laguna Cristal	LG	Natural river
2	Lagunita Cristal	LP-I	Irrigation canal 1
3	Lagunita Cristal	LP-II	Irrigation canal 2
4	Lagunita Cristal	LP-III	Drainage canal
5	Lagunita Cristal	LP-IV	Irrigation canal 1
6	Laguna Cueva	LC-I	Irrigation canal 1
7	Laguna Cueva	LC-II	Irrigation canal 2
8	Caño Cercado	CC	Small Stream
9	Caño Barraco	CB	Small Stream
10	Drenaje Cascarilla (road bridge)	DC-I	Main drainage canal (upper)
11	Drenaje Cascarilla (Los Caprices)	DC-II	Main drainage canal (lower)
12	Cueva Guaraguao	CG-I	Main stream
13	Cueva Guaraguao	CG-II	Irrigation canal
14	Rio Payabo (Represa)	RP-I-A	Main stream
15	Rio Payabo (Cano Ponton)	RP-I-B	Intake site of Ponton irrigation canal
16	Rio Payabo (Puente La Verde)	RP-II	Road bridge
17	Rio Payabo (Desembocadura)	RP-III	Confluence at Yuna river
18	Caño Ponton	PT	Ponton irrigation canal

Table B.4.1 Summary of Climate Condition in the Study Area

Station 1814 Barraquito : Data Period 1975 - 1993

Item		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Rainfall (mm)		114.7	97.2	118.0	167.7	314.6	184.9	197.0	209.1	162.4	178.2	192.4	129.5	2065.7
Monthly Distribution (%)		5.55%	4.70%	5.71%	8.12%	15.23%	8.95%	9.54%	10.12%	7.86%	8.63%	9.31%	6.27%	100.00%
Temperature (° C)		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Monthly Mean	Mean	23.6	23.6	24.2	25.4	26.1	26.9	26.9	26.9	27.0	26.5	25.5	24.1	25.6
	Max.	24.6	24.8	25.5	30.1	26.8	28.0	27.7	27.7	27.6	27.0	26.3	25.3	30.1
	Min.	21.5	20.9	22.7	23.5	25.2	25.5	26.2	26.3	26.3	25.9	24.7	23.2	20.9
Monthly Max.	Mean	31.2	31.7	32.1	32.8	33.1	33.5	33.4	33.3	34.0	33.3	32.5	31.6	32.7
	Max.	32.5	34.0	34.5	34.5	34.3	35.0	35.5	35.8	38.0	35.5	38.0	39.0	39.0
	Min.	30.0	30.0	24.5	29.5	32.0	32.0	32.0	32.0	33.0	32.0	31.0	29.5	24.5
Monthly Min.	Mean	15.6	15.1	15.8	17.2	19.1	20.7	20.8	20.9	20.5	20.1	18.3	16.6	18.4
	Max.	17.5	17.5	20.5	19.0	20.5	21.8	21.5	22.0	21.5	21.0	20.0	18.0	22.0
	Min.	11.8	13.5	11.5	12.0	15.2	19.5	20.0	20.0	20.0	18.0	15.0	14.0	11.5
Relative Humidity (%)	Mean	83.8	83.3	80.9	81.1	84.3	81.3	81.1	82.9	82.0	84.5	85.3	85.4	83.0
	Max.	92.2	93.0	92.7	94.2	92.5	90.6	88.0	96.2	90.4	97.1	96.6	96.0	97.1
	Min.	76.4	77.8	75.0	70.7	73.8	73.5	73.8	72.6	74.0	79.5	78.4	78.3	70.7
Evaporation (mm)	Mean	91.4	100.7	129.8	133.1	160.2	140.4	150.0	141.8	127.0	113.0	91.5	77.8	1456.8
	Max.	99.8	110.1	155.0	150.5	167.1	159.6	179.3	159.9	153.3	123.0	107.7	87.4	179.3
	Min.	78.1	86.1	110.2	96.3	145.9	121.4	129.8	126.1	98.3	101.4	77.9	70.2	70.2
Wind Velocity Monthly Mean (m/s)	Mean	1.4	1.4	1.5	1.7	1.3	1.2	1.1	1.0	1.2	1.1	1.0	1.1	1.3
	Max.	2.1	2.2	2.3	2.5	2.1	1.8	2.0	1.6	1.7	1.5	1.6	1.9	2.5
	Min.	0.8	0.8	0.6	0.9	0.4	0.6	0.2	0.2	0.7	0.7	0.4	0.5	0.2

Table B.5.1 Selected Rainfall Gauge Station for Thiesen Polygon

No.	Code	Name of Station	Thiesen Polygon Area (km2)				
			Villa Riva	El Limon	Abadesa	Confluence	Payabo
1	1802	JUMA BONAO	757	757	0	757	0
2	1807	JIMA RINCON	635	635	0	635	0
3	1814	BARRAQUITO	156	606	75	418	194
4	1821	LA CEIBA RIO BLANCO	405	405	0	405	0
5	1837	LA CABILMA	714	714	144	872	199
6	1847	S.F.DE MACORIS (MET)	875	875	0	875	0
7	1850	LA VEGA (MET)	479	479	0	479	0
8	1851	MOCA (MET)	659	659	0	659	0
Total			4680	5130	219	5101	393

Table B.5.2 Summary of Estimated Rainfall at Selected Stations
1958 to 1993

No.	Code	Name of Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	1802	JUMA BONAO	101.2	97.6	125.2	197.0	270.1	134.3	164.3	169.5	156.2	190.0	219.8	137.8	1962.9
2	1807	JIMA RINCON	75.9	82.3	77.1	107.7	185.7	105.1	102.0	134.8	103.5	123.4	139.5	100.9	1337.9
3	1814	BARRAQUITO	110.9	100.5	120.1	153.6	263.7	187.5	191.6	203.2	162.1	166.3	189.5	152.3	2001.5
4	1821	LA CEIBA RIO BLANCO	178.6	164.7	184.8	238.9	321.9	203.9	224.0	259.0	272.6	285.3	276.0	218.7	2828.4
5	1837	LA CABILMA	104.0	108.2	110.5	150.1	259.6	170.2	200.1	216.3	168.9	160.1	177.6	150.3	1975.9
6	1847	S.F.DE MACORIS (MET)	84.6	74.2	73.5	102.0	183.6	118.6	116.9	144.9	111.2	121.5	156.2	124.0	1411.1
7	1850	LA VEGA (MET)	83.0	71.7	92.4	151.4	201.2	89.3	96.9	109.4	111.6	144.6	138.4	114.4	1404.2
8	1851	MOCA (MET)	68.5	62.5	67.8	103.0	162.3	71.6	91.8	93.0	101.6	126.3	136.6	109.3	1194.4

Table B.5.3 Estimated Annual Rainfall Pattern

No.	Calculation Point	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	Villa Riva	95.7	91.1	100.3	144.2	222.9	127.2	141.4	159.3	140.6	157.5	174.4	133.2	1687.8
2	El Limon	97.0	91.9	102.1	145.1	226.5	132.5	145.8	163.1	142.5	158.2	175.7	134.9	1715.4
3	Abadesa	106.4	105.6	113.8	151.3	261.0	176.1	197.2	211.8	166.6	162.2	181.7	151.0	1984.7
4	Payabo Confruence at Yuna	96.7	92.1	101.7	144.9	226.1	131.7	145.8	163.3	142.6	158.0	175.3	134.7	1712.9
5	Payabo Basin	107.4	104.4	115.3	151.8	261.6	178.7	195.9	209.8	165.5	163.2	183.5	151.3	1988.6

Table B.5.4 Rainfall Probability Analysis

1814 BARRAQUITO								
Return Period	F[%]	Annual Rainfall (mm)	Maximum 24 hr Rainfall (mm)	Maximum 3 Day Rainfall (mm)	Continuous days without Rainfall (days)			
					less than 0.1 mm		less than 5.0 mm	
					Rainy Season	Dry Season	Rainy Season	Dry Season
1/200	0.50	1262.2	233.1	336.5	12	30	21	51
1/100	1.00	1321.1	215.2	308.1	12	27	20	48
1/50	2.00	1388.7	197.2	280.1	11	24	19	44
1/20	5.00	1496.4	173.0	243.4	10	21	18	39
1/10	10.00	1599.1	154.0	215.4	10	18	17	35
1/ 5	20.00	1733.0	133.7	186.5	9	16	16	31
1/ 2	50.00	2021.1	102.1	143.4	8	12	13	24

1811 Abadesa								
Return Period	F[%]	Annual Rainfall (mm)	Maximum 24 hr Rainfall (mm)	Maximum 3 Day Rainfall (mm)	Continuous days without Rainfall (days)			
					less than 0.1 mm		less than 5.0 mm	
					Rainy Season	Dry Season	Rainy Season	Dry Season
1/200	0.50	907.2	143.7	212.3	29	67	29	86
1/100	1.00	980.7	136.5	203.4	26	58	27	78
1/50	2.00	1062.3	128.9	193.8	23	50	25	70
1/20	5.00	1186.8	117.9	179.6	20	40	22	60
1/10	10.00	1299.9	108.5	167.3	17	33	20	52
1/ 5	20.00	1440.1	97.7	152.8	14	26	18	44
1/ 2	50.00	1718.1	78.6	125.8	10	18	14	31

Table B.5.5 Water Balance in the Yuna River Basin

Villa Riva (Catchment Area 4680 km2)													
Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Discharge (m3/s)													
1958-1978	71.98	60.41	58.93	81.98	130.57	100.24	74.34	79.80	62.12	87.40	108.22	99.87	84.65
1979-1982	55.55	62.32	67.71	133.13	325.35	219.96	128.48	166.66	45.22	103.77	184.45	80.96	131.13
1983-1991	77.39	121.34	44.76	55.86	154.21	115.29	54.35	60.85	58.41	88.65	165.28	110.19	92.21
1958-1991	71.58	74.35	56.30	80.25	155.52	116.23	74.42	84.06	60.64	88.84	127.25	100.83	90.86
Runoff (mm)													
1958-1978	41.19	31.23	33.73	45.41	74.73	55.52	42.54	45.67	34.41	50.02	59.94	57.16	570.44
1979-1982	31.79	32.21	38.75	73.73	186.20	121.82	73.53	95.38	25.04	59.39	102.16	46.33	883.61
1983-1991	44.29	62.72	25.62	30.94	88.25	63.85	31.10	34.82	32.35	50.74	91.54	63.06	621.38
1958-1991	40.97	38.43	32.22	44.44	89.01	64.37	42.59	48.11	33.59	50.84	70.48	57.71	612.23
Mean Rainfall (mm)													
1958-1978	83.0	85.8	98.5	140.5	192.2	123.4	139.1	153.1	131.2	145.4	164.4	138.8	1595.5
1979-1982	108.0	109.6	97.8	154.1	357.8	151.4	169.3	236.3	156.5	145.4	187.0	154.2	2027.4
1983-1991	112.8	101.3	95.3	131.8	203.4	131.4	139.0	146.3	161.7	208.0	199.7	116.3	1747.1
1958-1991	95.7	91.1	100.3	144.2	222.9	127.2	141.4	159.3	140.6	157.5	174.4	133.2	1687.8
Runoff Coefficient (%)													
1958-1978	49.6%	36.4%	34.2%	32.3%	38.9%	45.0%	30.6%	29.8%	26.2%	34.4%	36.5%	41.2%	35.8%
1979-1982	29.4%	29.4%	39.6%	47.9%	52.0%	80.4%	43.4%	40.4%	16.0%	40.8%	54.6%	30.0%	43.6%
1983-1991	39.3%	61.9%	26.9%	23.5%	43.4%	48.6%	22.4%	23.8%	20.0%	24.4%	45.9%	54.2%	35.6%
1958-1991	42.8%	42.2%	32.1%	30.8%	39.9%	50.6%	30.1%	30.2%	23.9%	32.3%	40.4%	43.3%	36.3%
El Limon (Catchment Area 5130 km2)													
Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Discharge (m3/s)													
1969-1978	75.86	68.11	63.88	68.03	94.78	48.01	46.18	66.44	77.37	94.77	119.53	126.54	79.12
1979-1982	63.21	69.71	63.95	124.95	286.62	203.84	126.06	160.30	156.70	113.99	173.16	83.77	135.52
1982-1993	90.03	118.75	67.65	67.92	146.79	127.50	69.54	80.24	78.68	100.32	127.77	109.27	98.70
1969-1993	80.57	90.04	65.53	75.09	142.60	104.34	67.77	84.50	88.72	99.69	130.21	113.45	95.21
Runoff (mm)													
1969-1978	39.60	32.12	33.35	34.37	49.48	24.26	24.11	34.69	39.09	49.48	60.39	66.07	486.40
1979-1982	33.00	32.87	33.39	63.13	149.65	102.99	65.81	83.70	79.18	59.52	87.49	43.74	833.10
1982-1993	47.00	56.00	35.32	34.32	76.64	64.42	36.30	41.89	39.75	52.38	64.56	57.05	606.77
1969-1993	42.07	42.46	34.21	37.94	74.45	52.72	35.38	44.12	44.83	52.05	65.79	59.23	585.29
Mean Rainfall (mm)													
1969-1978	79.9	101.1	101.7	150.7	182.5	105.9	133.5	167.3	139.1	163.3	169.3	151.1	1645.4
1979-1982	108.8	111.5	97.0	154.5	366.7	157.4	172.8	241.5	155.1	146.9	186.8	158.0	2057.2
1982-1993	116.5	94.1	107.0	147.5	237.3	130.8	140.5	146.0	155.5	184.4	188.7	113.4	1761.8
1969-1993	100.7	99.7	103.3	149.9	236.1	125.1	142.9	169.8	148.9	170.0	180.6	135.6	1762.5
Runoff Coefficient (%)													
1969-1978	49.6%	31.8%	32.8%	22.8%	27.1%	22.9%	18.1%	20.7%	28.1%	30.3%	35.7%	43.7%	29.6%
1979-1982	30.3%	29.5%	34.4%	40.9%	40.8%	65.4%	38.1%	34.7%	51.0%	40.5%	46.8%	27.7%	40.5%
1982-1993	40.3%	59.5%	33.0%	23.3%	32.3%	49.2%	25.8%	28.7%	25.6%	28.4%	34.2%	50.3%	34.4%
1969-1993	41.8%	42.6%	33.1%	25.3%	31.5%	42.1%	24.8%	26.0%	30.1%	30.6%	36.4%	43.7%	33.2%

Table B.5.6 Probability Analysis of Mean and Low Flow at Villa Riva and El Limon

(m3/s)

Return Period	F[%]	Villa Riva				El Limon			
		Mean		Minimum		Mean		Minimum	
		Before	After	Before	After	Before	After	Before	After
1/200	0.50	29.07	46.90	2.15	8.23	48.21	63.43	1.43	4.27
1/100	1.00	32.89	50.42	2.56	9.06	50.26	65.59	2.25	5.59
1/50	2.00	37.30	54.46	3.08	10.07	52.62	68.21	3.20	7.19
1/20	5.00	44.40	60.89	4.03	11.78	56.35	72.70	4.76	9.91
1/10	10.00	51.25	67.00	5.10	13.55	59.91	77.33	6.29	12.72
1/5	20.00	60.29	74.95	6.75	16.05	64.52	83.90	8.34	16.68
1/2	50.00	80.15	91.97	11.42	22.19	74.38	100.10	12.98	26.39

Table B.5.7 Runoff Pattern at Abadesa

From 1972 to 1979

Item	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Discharge (m3/s)	2.400	2.485	3.867	4.812	8.812	17.725	10.041	14.616	17.530	12.866	10.796	5.085	9.269
Runoff (mm)	29.4	27.5	47.3	57.0	107.8	209.8	122.8	178.8	207.5	157.3	127.8	62.2	1334.7
Rainfall (mm)	107.7	129.2	136.2	181.9	225.7	188.6	207.2	256.1	199.3	204.0	196.1	201.0	2233.0
Runoff Coefficient (%)	27.2%	21.3%	34.7%	31.3%	47.7%	111.2%	59.3%	69.8%	104.1%	77.1%	65.2%	30.9%	59.8%

Table B.5.8 Estimated Runoff Pattern at the Diversion Point of the Payabo River

Item	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Discharge (m3/s)	3.356	3.338	5.469	7.167	12.960	25.181	14.006	21.036	24.358	18.371	15.974	7.267	13.245
Runoff (mm)	26.1	23.4	42.5	53.8	100.6	189.2	108.7	163.3	183.0	142.6	120.0	56.4	1210.7
Rainfall (mm)	103.7	119.4	132.6	186.5	228.5	184.4	199.0	253.6	190.6	200.4	199.7	197.7	2196.0
Runoff Coefficient (%)	25.1%	19.6%	32.0%	28.9%	44.0%	102.6%	54.7%	64.4%	96.0%	71.2%	60.1%	28.5%	55.1%

Table B.5.9 Probability Analysis of Mean and Low Flow for the Payabo River

(m3/s)

Return Period	F[%]	Abadesa		Diversion point at Payabo	
		Mean Discharge	Minimum Discharge	Mean Discharge	Minimum Discharge
1/200	0.50	3.82	0.08	5.46	0.21
1/100	1.00	4.13	0.13	5.90	0.30
1/50	2.00	4.49	0.19	6.42	0.41
1/20	5.00	5.12	0.30	7.31	0.59
1/10	10.00	5.75	0.40	8.22	0.76
1/ 5	20.00	6.64	0.53	9.49	0.98
1/ 2	50.00	8.80	0.85	12.57	1.46

Table B.5.10 Previous Spring Discharge Data

No.	Name of Spring	Period of Data Collected	Number of Data	Discharge (m3/s)		
				Mean	Max.	Min.
1	Guaraguao Main	10/1/75 - 18/7/94	110	1.787	5.019	0.701
2	Guaraguao Second	17/2/76 - 12/11/91	14	0.672	2.123	0.219
3	Cercado	17/2/76 - 25/4/76	10	0.596	1.141	0.363
4	Laguna Cristal	27/3/76 - 25/4/76	5	0.567	0.597	0.541

Table B.5.11 Result of Spring Water discharge Measurement in the Study Area

(Unit: m^3/s)

Year	Month	Date	Guaragao	La Cueva	Lagunita Cristal	Laguna Cristal	Caño Cercado	Source
1994	Aug	19	2.128	0.382	1.481	0.428	0.624	INDRHI
	Sep	7	1.485	0.511	-	-	-	"
		16	1.429	0.654	1.156	0.446	0.538	"
		28	1.268	0.936	1.449	0.684	0.547	"
	Oct	11	1.808	0.913	1.567	0.435	0.495	"
	Nov	17	1.510	0.678	2.062	0.541	0.670	"
	Dec	6	2.246	0.598	2.353	0.756	1.048	"
1995	Jan	10	1.138	0.373	1.750	0.499	0.639	"
	Feb	7	1.496	0.400	0.820	0.473	0.895	JICA team
		10	1.236	0.323	0.633	0.547	0.871	"
		13	1.694	0.314	0.821	0.519	0.969	"
		16	1.629	0.323	0.654	0.546	0.831	"
		20	-	0.279	0.760	0.501	0.739	"
		23	1.626	0.309	-	0.536	0.952	"
		27	1.688	0.356	-	0.510	0.766	"
	Mar	2	1.533	0.355	0.777	0.506	0.838	"
		6	1.863	0.286	0.742	0.528	0.752	"
		9	-	-	-	0.551	-	"
Average			1.611	0.470	1.216	0.530	0.761	
Portion for Guraguao			100.0%	29.2%	75.5%	32.9%	47.2%	

Table B.5.12 Result of Discharge Measurement at Guaraguao (1/3)

unit: m^3/s

Date			Time	Main Canal	Sub Canal	Total	Remark
18	Aug.	94	15:47	1.349	0.277	1.626	
19	Aug.	94	7:01	1.263	0.318	1.581	
19	Aug.	94	4:53	1.458	0.161	1.619	
20	Aug.	94	7:00	1.739	0.234	1.973	
20	Aug.	94	4:52	1.564	0.486	2.050	
21	Aug.	94	7:10	1.289	0.391	1.680	
21	Aug.	94	3:41	1.320	0.298	1.618	
22	Aug.	94	7:24	1.284	0.392	1.676	
22	Aug.	94	4:59	1.209	0.386	1.595	
23	Aug.	94	5:22	1.302	0.260	1.561	
25	Aug.	94	7:03	1.351	0.324	1.675	
26	Aug.	94	-	1.144	0.324	1.468	
28	Aug.	94	-	1.739	0.486	2.050	
31	Aug.	94	6:42	1.356	0.073	1.429	
1	Sep.	94	7:00	1.765	0.243	2.008	
1	Sep.	94	5:06	1.119	0.276	1.394	
2	Sep.	94	7:00	1.089	0.318	1.407	
2	Sep.	94	5:00	1.739	0.221	1.960	
3	Sep.	94	7:00	1.198	0.407	1.605	
3	Sep.	94	5:00	1.173	0.250	1.423	
4	Sep.	94	7:00	1.211	0.292	1.503	
4	Sep.	94	5:00	1.224	0.266	1.491	
7	Sep.	94	7:05	1.302	0.218	1.520	
7	Sep.	94	5:00	1.414	0.248	1.662	
8	Sep.	94	7:01	1.741	0.211	1.952	
8	Sep.	94	5:00	1.373	nil	1.373	Sub canal is closed
9	Sep.	94	7:00	1.643	nil	1.643	due to gate construction
9	Sep.	94	5:00	1.675	nil	1.675	
10	Sep.	94	7:00	1.518	nil	1.518	
10	Sep.	94	5:00	1.443	nil	1.443	
11	Sep.	94	5:00	1.586	nil	1.586	
14	Sep.	94	7:00	0.497	0.646	1.143	
16	Sep.	94	7:09	1.493	0.385	1.878	
16	Sep.	94	17:00	1.364	0.388	1.752	
17	Sep.	94	7:23	1.534	0.366	1.900	
17	Sep.	94	17:10	1.260	0.247	1.507	
18	Sep.	94	7:19	1.402	0.270	1.672	
18	Sep.	94	17:00	1.193	0.348	1.541	
19	Sep.	94	7:07	1.309	0.353	1.662	
19	Sep.	94	17:00	1.443	0.213	1.656	
20	Sep.	94	7:14	1.328	0.190	1.518	
20	Sep.	94	17:00	1.306	0.226	1.532	
21	Sep.	94	17:00	1.213	0.354	1.567	
23	Sep.	94	17:00	1.424	0.029	1.453	
24	Sep.	94	17:00	1.346	0.253	1.599	
25	Sep.	94	17:00	1.641	0.426	2.067	
26	Sep.	94	17:00	1.494	0.448	1.942	
27	Sep.	94	17:00	1.752	0.652	2.404	
28	Sep.	94	17:00	1.481	0.429	1.910	
29	Sep.	94	17:00	1.295	0.418	1.713	
30	Sep.	94	17:00	1.284	0.344	1.628	
1	Oct.	94	17:00	1.114	0.316	1.430	
2	Oct.	94	17:00	1.255	0.256	1.511	
3	Oct.	94	17:00	1.043	0.305	1.348	
4	Oct.	94	17:00	1.092	0.321	1.413	

Table B.5.12 Result of Discharge Measurement at Guaraguao (2/3)

unit: m^3/s

Date			Time	Main Canal	Sub Canal	Total	Remark
5	Oct.	94	17:00	1.135	0.271	1.406	
6	Oct.	94	17:00	1.083	0.304	1.387	
7	Oct.	94	17:00	1.285	0.311	1.596	
8	Oct.	94	17:00	1.304	0.305	1.609	
9	Oct.	94	17:00	1.204	0.237	1.441	
11	Oct.	94	17:00	1.540	0.322	1.862	
14	Oct.	94	17:08	1.363	0.320	1.683	
15	Oct.	94	17:00	1.456	0.275	1.731	
17	Oct.	94	17:00	1.446	0.315	1.761	
18	Oct.	94	17:00	1.951	0.000	1.951	
19	Oct.	94	17:00	1.226	0.412	1.638	
20	Oct.	94	17:00	1.675	0.321	1.996	
21	Oct.	94	17:00	1.397	0.265	1.662	
22	Oct.	94	17:00	1.459	0.260	1.719	
23	Oct.	94	17:00	1.398	0.229	1.627	
25	Oct.	94	17:00	1.777	0.123	1.900	
28	Oct.	94	17:00	1.614	0.222	1.836	
29	Oct.	94	17:00	1.290	0.233	1.523	
30	Oct.	94	17:00	1.423	0.271	1.694	
31	Oct.	94	17:00	1.507	0.129	1.636	
1	Nov.	94	17:00	1.465	0.268	1.733	
2	Nov.	94	17:00	1.324	0.323	1.647	
3	Nov.	94	17:00	1.286	0.200	1.486	
4	Nov.	94	17:00	1.321	0.124	1.445	
5	Nov.	94	17:00	1.282	0.197	1.479	
6	Nov.	94	17:00	1.341	0.189	1.530	
7	Nov.	94	17:00	1.663	0.164	1.827	
9	Nov.	94	17:00	1.450	0.106	1.556	
12	Nov.	94	17:00	1.293	nil	1.293	
13	Nov.	94	17:00	1.581	0.375	1.956	
14	Nov.	94	17:00	1.569	0.286	1.855	
15	Nov.	94	17:00	1.350	0.257	1.607	
16	Nov.	94	17:00	1.299	0.299	1.598	
17	Nov.	94	17:00	1.577	0.309	1.886	
18	Nov.	94	17:00	1.304	0.242	1.546	
19	Nov.	94	17:00	1.344	0.290	1.634	
20	Nov.	94	17:00	1.387	0.233	1.620	
21	Nov.	94	17:00	1.577	0.243	1.820	
23	Nov.	94	17:00	1.298	0.250	1.548	
28	Nov.	94	17:00	1.276	0.280	1.556	
29	Nov.	94	17:00	1.188	0.298	1.486	
30	Nov.	94	17:00	1.295	0.269	1.564	
1	Dec	94	17:00	1.289	0.276	1.565	
2	Dec	94	17:00	1.597	0.304	1.901	
3	Dec	94	17:00	1.105	0.292	1.397	
4	Dec	94	17:00	1.429	0.257	1.686	
5	Dec	94	17:00	1.445	0.283	1.728	
6	Dec	94	17:00	2.059	0.306	2.365	
7	Dec	94	17:00	1.966	0.229	2.195	
8	Dec	94	17:00	1.404	0.242	1.646	
9	Dec	94	17:00	1.380	0.288	1.668	
11	Dec	94	17:00	1.074	0.304	1.378	
14	Dec	94	17:00	1.482	0.332	1.814	
15	Dec	94	17:00	1.381	0.261	1.642	
16	Dec	94	17:00	1.414	0.274	1.688	

Table B.5.12 Result of Discharge Measurement at Guaraguao (3/3)

unit: m^3/s

Date			Time	Main Canal	Sub Canal	Total	Remark
17	Dec	94	17:00	1.159	0.190	1.349	
18	Dec	94	17:00	1.130	0.318	1.448	
19	Dec	94	17:00	1.323	0.262	1.585	
20	Dec	94	17:00	1.371	0.250	1.621	
21	Dec	94	17:00	1.383	0.298	1.681	
22	Dec	94	17:00	1.466	0.292	1.758	
23	Dec	94	17:00	1.398	0.280	1.678	
25	Dec	94	17:00	1.395	0.376	1.771	
28	Dec	94	17:00	1.608	0.000	1.608	
29	Dec	94	17:00	1.338	0.194	1.532	
30	Dec	94	17:00	1.311	0.284	1.595	
31	Dec	94	17:00	1.256	0.263	1.519	
2	Jan.	95	17:00	1.181	0.347	1.528	
3	Jan.	95	17:00	1.117	0.210	1.327	
4	Jan.	95	17:00	1.258	0.330	1.588	
5	Jan.	95	17:00	1.114	0.283	1.397	
6	Jan.	95	17:00	1.252	0.262	1.514	
7	Jan.	95	17:00	1.503	0.254	1.757	
8	Jan.	95	17:00	1.288	0.258	1.546	
9	Jan.	95	17:00	1.433	0.215	1.648	
10	Jan.	95	17:00	1.017	0.380	1.397	
14	Jan.	95	17:00	1.235	0.292	1.527	
15	Jan.	95	17:00	1.332	0.344	1.676	
16	Jan.	95	17:00	1.226	0.201	1.427	
18	Jan.	95	17:00	1.263	0.214	1.477	
19	Jan.	95	17:00	1.262	0.456	1.718	
20	Jan.	95	17:00	1.281	0.356	1.637	
21	Jan.	95	17:00	1.193	0.362	1.555	
22	Jan.	95	17:00	1.439	0.143	1.582	
23	Jan.	95	17:00	1.205	0.328	1.533	
24	Jan.	95	17:00	1.354	0.379	1.733	
25	Jan.	95	17:00	1.385	0.371	1.756	
26	Jan.	95	17:00	1.458	0.221	1.679	
30	Jan.	95	17:00	1.204	0.300	1.504	
1	Feb	95	17:00	0.986	0.109	1.095	
2	Feb	95	17:00	1.285	0.205	1.490	
3	Feb	95	17:00	1.209	0.216	1.425	
4	Feb	95	17:00	1.229	0.261	1.490	
5	Feb	95	17:00	1.371	0.240	1.611	
6	Feb	95	17:00	1.167	0.251	1.418	
7	Feb	95	17:00	1.079	0.296	1.375	
8	Feb	95	17:00	0.804	0.386	1.190	
9	Feb	95	17:00	0.943	0.259	1.202	
10	Feb	95	17:00	0.805	0.254	1.059	
14	Feb	95	17:00	1.402	0.250	1.652	
15	Feb	95	17:00	1.161	0.211	1.372	
16	Feb	95	17:00	1.103	0.330	1.433	
22	Feb	95	17:00	1.356	0.344	1.700	
23	Feb	95	17:00	1.112	0.327	1.439	
24	Feb	95	17:00	1.094	0.213	1.307	
25	Feb	95	17:00	1.119	0.295	1.414	
26	Feb	95	17:00	1.142	0.223	1.365	
27	Feb	95	17:00	1.238	0.278	1.516	

Table B.6.13 Estimation of Spring Water Discharge at Caño Ponton

Observation (1) / Date; Feb 7, 1995

	Location	Discharge Area A (m2)	Mean Velocity V (m/s)	Discharge (m3/s)	Total (Qin,Qo) (m3/s)	Qx = Qo-Qin (m3/s)
Qin	Payabo River	5.503	0.202	1.112	1.112	
Qo1	Canal A	0.000	0.000	0.000		
Qo2	Arrenquin Canal	1.128	0.272	0.307		
Qo3	Arrenquin Canal	1.817	0.482	0.875	1.753	0.641
Qo4	Ponton Canal	1.927	0.296	0.570		
Qo5	Canal B	*	*	0.001		

Observation (2) / Date; Feb 17, 1995

	Location	Discharge Area A (m2)	Mean Velocity V (m/s)	Discharge (m3/s)	Total (Qin,Qo) (m3/s)	Qx = Qo-Qin (m3/s)
Qin	Payabo River	6.175	0.164	1.015	1.015	
Qo1	Canal A					
Qo2	Arrenquin Canal	0.414	0.297	0.123		
Qo3	Arrenquin Canal	0.637	0.474	0.302	1.179	0.164
	Pump	0.260	0.169	0.044		
Qo4	Ponton Canal	2.400	0.296	0.710		
Qo5	Canal B	*	*	0.000		

Observation (3) /Date; Feb 28, 1995

	Location	Discharge Area A (m2)	Mean Velocity V (m/s)	Discharge (m3/s)	Total (Qin,Qo) (m3/s)	Qx = Qo-Qin (m3/s)
Qin	Payabo River	6.364	0.188	1.195	1.195	
Qo1	Canal A					
Qo2	Arrenquin Canal	0.769	0.384	0.295		
Qo3	Arrenquin Canal	2.313	0.510	1.179	2.340	1.145
Qo4	Ponton Canal	3.007	0.288	0.866		
Qo5	Canal B	*	*	0.000		

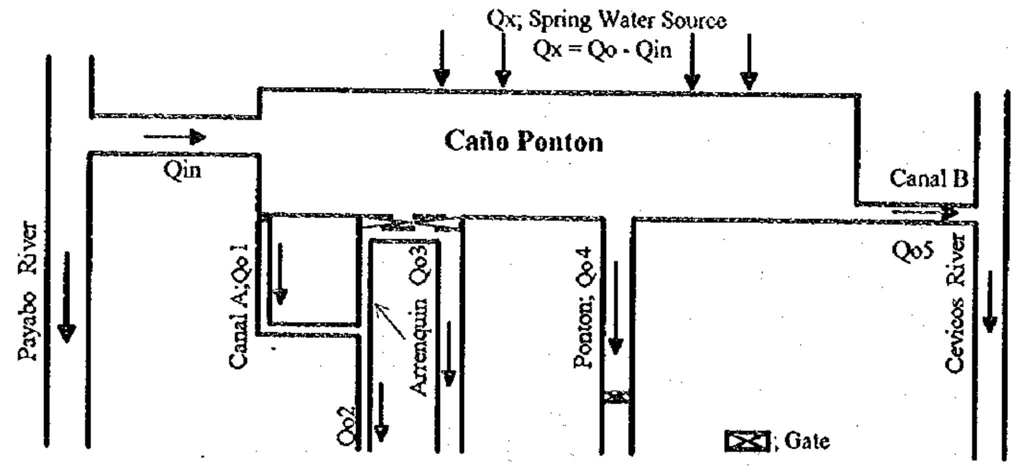


Table B.5.14 Probability Analysis of High Flow at Villa Riva and El Limon

(m3/s)

Return Period	F[%]	Villa Riva		El Limon	
		Before	After	Before	After
1/200	0.50	1369.71	1115.23	-	-
1/100	1.00	1280.15	1060.77	-	-
1/50	2.00	1187.04	1004.26	-	-
1/20	5.00	1056.48	925.22	630.00	750.00
1/10	10.00	948.81	860.22	612.63	715.09
1/5	20.00	828.10	787.56	559.10	647.93
1/2	50.00	623.92	665.23	469.38	530.57

Table B.5.15 Probability Analysis of High Flow at the Payabo River

Return Period	F[%]	Abadesa	Diversion Point at Payabo
		Maximum Discharge (m3/s)	Maximum Discharge (m3/s)
1/200	0.50	544.07	600.30
1/100	1.00	494.84	545.98
1/50	2.00	445.21	491.23
1/20	5.00	378.36	417.46
1/10	10.00	325.69	359.35
1/5	20.00	269.37	297.21
1/2	50.00	180.94	199.64

Table B.5.16 Estimated Flood Discharge in the Study Area

Return Period 1/2	Maximum 24hr Rainfall (mm) 102.1	Runoff Coefficient 0.75	Duration Time C 220	Return Period 1/5	Maximum 24hr Rainfall (mm) 133.7	Runoff Coefficient 0.75	Duration Time C 220
Catchment Area (km2)	Duration Time (hr)	Rainfall Intensity (mm/hr)	Peak Discharge (m3/s)	Catchment Area (km2)	Duration Time (hr)	Rainfall Intensity (mm/hr)	Peak Discharge (m3/s)
10	2.46	13.286	27.679	10	2.19	18.422	38.379
20	2.96	12.113	50.471	20	2.64	16.796	69.982
30	3.30	11.475	71.722	30	2.94	15.912	99.448
40	3.56	11.044	92.029	40	3.18	15.313	127.608
50	3.78	10.720	111.665	50	3.37	14.864	154.834
60	3.97	10.462	130.780	60	3.54	14.507	181.337
70	4.13	10.250	149.472	70	3.69	14.212	207.256
80	4.28	10.069	167.811	80	3.82	13.961	232.684
Return Period 1/10	Maximum 24hr Rainfall (mm) 154.0	Runoff Coefficient 0.75	Duration Time C 220	Return Period 1/20	Maximum 24hr Rainfall (mm) 173.0	Runoff Coefficient 0.75	Duration Time C 220
Catchment Area (km2)	Duration Time (hr)	Rainfall Intensity (mm/hr)	Peak Discharge (m3/s)	Catchment Area (km2)	Duration Time (hr)	Rainfall Intensity (mm/hr)	Peak Discharge (m3/s)
10	2.07	21.865	45.552	10	1.97	25.176	52.450
20	2.49	19.935	83.062	20	2.37	22.954	95.641
30	2.77	18.885	118.034	30	2.64	21.746	135.910
40	2.99	18.175	151.457	40	2.85	20.927	174.394
50	3.17	17.642	183.771	50	3.02	20.314	211.602
60	3.33	17.218	215.229	60	3.17	19.826	247.824
70	3.47	16.868	245.990	70	3.31	19.423	283.247
80	3.60	16.570	276.170	80	3.43	19.080	317.998
Return Period 1/50	Maximum 24hr Rainfall (mm) 197.2	Runoff Coefficient 0.75	Duration Time C 220	Return Period 1/100	Maximum 24hr Rainfall (mm) 215.2	Runoff Coefficient 0.75	Duration Time C 220
Catchment Area (km2)	Duration Time (hr)	Rainfall Intensity (mm/hr)	Peak Discharge (m3/s)	Catchment Area (km2)	Duration Time (hr)	Rainfall Intensity (mm/hr)	Peak Discharge (m3/s)
10	1.86	29.507	61.472	10	1.79	32.802	68.338
20	2.24	26.901	112.090	20	2.16	29.906	124.608
30	2.49	25.486	159.287	30	2.40	28.332	177.076
40	2.69	24.526	204.387	40	2.60	27.266	227.214
50	2.86	23.807	247.994	50	2.75	26.466	275.692
60	3.00	23.236	290.446	60	2.89	25.831	322.885
70	3.13	22.763	331.961	70	3.01	25.305	369.036
80	3.24	22.361	372.689	80	3.12	24.859	414.313
Return Period 1/200	Maximum 24hr Rainfall (mm) 233.1	Runoff Coefficient 0.75	Duration Time C 220				
Catchment Area (km2)	Duration Time (hr)	Rainfall Intensity (mm/hr)	Peak Discharge (m3/s)				
10	1.73	36.138	75.287				
20	2.09	32.947	137.280				
30	2.32	31.213	195.084				
40	2.51	30.038	250.320				
50	2.66	29.158	303.728				
60	2.80	28.458	355.720				
70	2.91	27.879	406.564				
80	3.02	27.387	456.446				

Table B.5.17 Summary of Sediment Runoff

Code	Station	Catchment Area (km2)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Sediment Runoff (t)															
180003	Villa Riva	4680	41706	45834	32994	53024	135368	89295	44770	53127	30606	58617	95804	70645	751790
180004	El Limon	5130	39807	54893	33668	43074	121355	75236	31409	52729	49568	57737	92658	86077	738210
187002	Abadesa	219	381	383	540	1198	3110	4020	1839	3503	3756	2654	1841	962	24186
-	Payabo	345	600	603	851	1888	4899	6332	2896	5518	5917	4181	2900	1515	38100
Specific Sediment Runoff (t/km2)															
180003	Villa Riva	4680	8.91	9.79	7.05	11.33	28.92	19.08	9.57	11.35	6.54	12.53	20.47	15.10	160.64
180004	El Limon	5130	7.76	10.70	6.56	8.40	23.66	14.67	6.12	10.28	9.66	11.25	18.06	16.78	143.90
187002	Abadesa	219	1.74	1.75	2.47	5.47	14.20	18.35	8.40	15.99	17.15	12.12	8.41	4.39	110.44
-	Payabo	345	1.74	1.75	2.47	5.47	14.20	18.35	8.40	15.99	17.15	12.12	8.41	4.39	110.44
Estimated Specific Sediment Runoff (m3/km2)															
180003	Villa Riva	4680	16.04	17.63	12.69	20.39	52.06	34.34	17.22	20.43	11.77	22.55	36.85	27.17	289.15
180004	El Limon	5130	13.97	19.26	11.81	15.11	42.58	26.40	11.02	18.50	17.39	20.26	32.51	30.20	259.02
187002	Abadesa	219	3.13	3.14	4.44	9.85	25.56	33.04	15.11	28.79	30.87	21.82	15.13	7.91	198.78
-	Payabo	345	3.13	3.14	4.44	9.85	25.56	33.04	15.11	28.79	30.87	21.82	15.13	7.91	198.78

Table B.5.18 The Result of Discharge Measurement in the Study Area

Site	Date	Code	Gauge Height (m)	Flow Area (m2)	Mean Velocity (m/s)	Discharge (m3/s)	Remark
Laguna Cristal	19/8/94	LG	0.33	1.410	0.304	0.428	
	16/9/94	LG	0.33	1.120	0.398	0.446	
Lagunita Cristal	19/8/94	LP-I	0.52	1.350	0.191	0.258	
		LP-II	0.47	0.810	0.246	0.199	
		LP-III	0.15	0.280	0.168	0.047	
		LP-IV	0.67	4.320	0.226	0.977	1.481
	16/9/94	LP-I	0.43	0.240	0.304	0.073	
		LP-II	0.54	0.900	0.137	0.123	
		LP-III	-	0.000	0.000	0.000	
		LP-IV	0.70	4.140	0.232	0.960	1.156
Cano Cercado	19/8/94	CC	-	5.620	0.111	0.624	
	16/9/94		-	4.600	0.117	0.538	
Cano Barraco	19/8/94	CB	-	1.910	0.043	0.082	
	15/9/94		-	0.950	0.056	0.053	
Drenaje Cascarilla (road bridge)	19/8/94	DC-I	-	5.950	0.101	0.598	
	15/9/94		-	9.620	0.087	0.837	
Drenaje Cascarilla (Los Caprices)	19/8/94	DC-II	-	13.910	0.081	1.128	
	15/9/94		-	21.480	0.050	1.068	
Laguna Cueva	19/8/94	LC-I	-	1.250	0.284	0.355	
		LC-II	-	0.240	0.113	0.027	0.382
	16/9/94	LC-I	0.59	1.460	0.440	0.642	
		LC-II	0.31	0.170	0.071	0.012	0.654
Cueva Guaraguao	19/8/94	CG-I	-	3.980	0.429	1.708	
		CG-II	-	2.360	0.178	0.420	2.128
	16/9/94	CG-I	0.90	2.590	0.401	1.038	
		CG-II	0.70	2.840	0.138	0.391	1.429
Rio Payabo Diversion Point	15/9/94	RP-I-A	-	8.410	0.181	1.522	
	15/9/94	RP-I-B	-	8.330	0.610	5.080	6.602
Rio Payabo (Puente La Verde)	15/9/94	RP-II	1.54	17.600	0.423	7.449	
Rio Payabo (Desembocadura)	15/9/94	PR-III	-	12.680	0.607	7.699	

ANNEX B : FIGURES

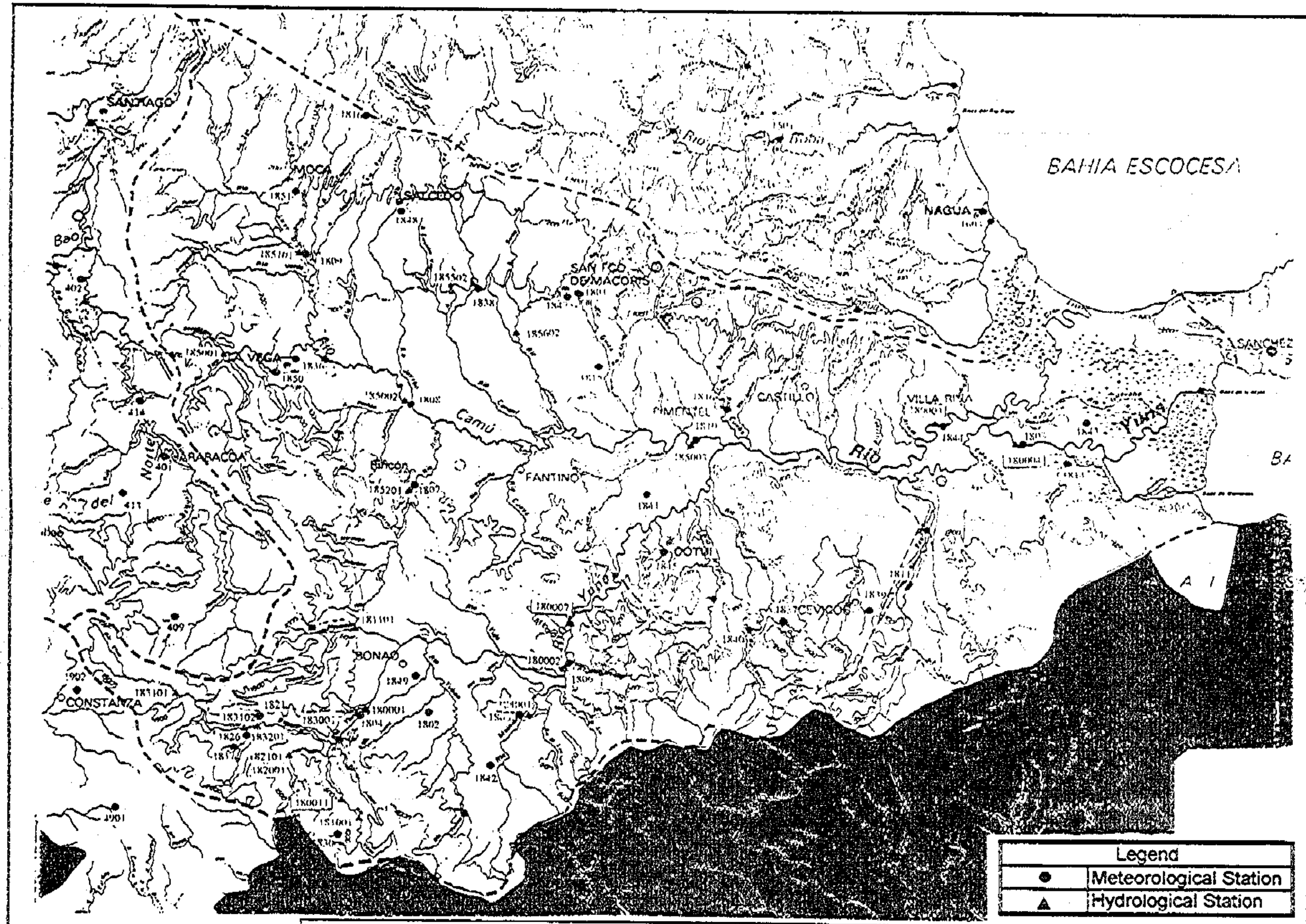


Fig. B.2.1 Location of Meteo-hydrological Stations in and around the Yuna River Basin

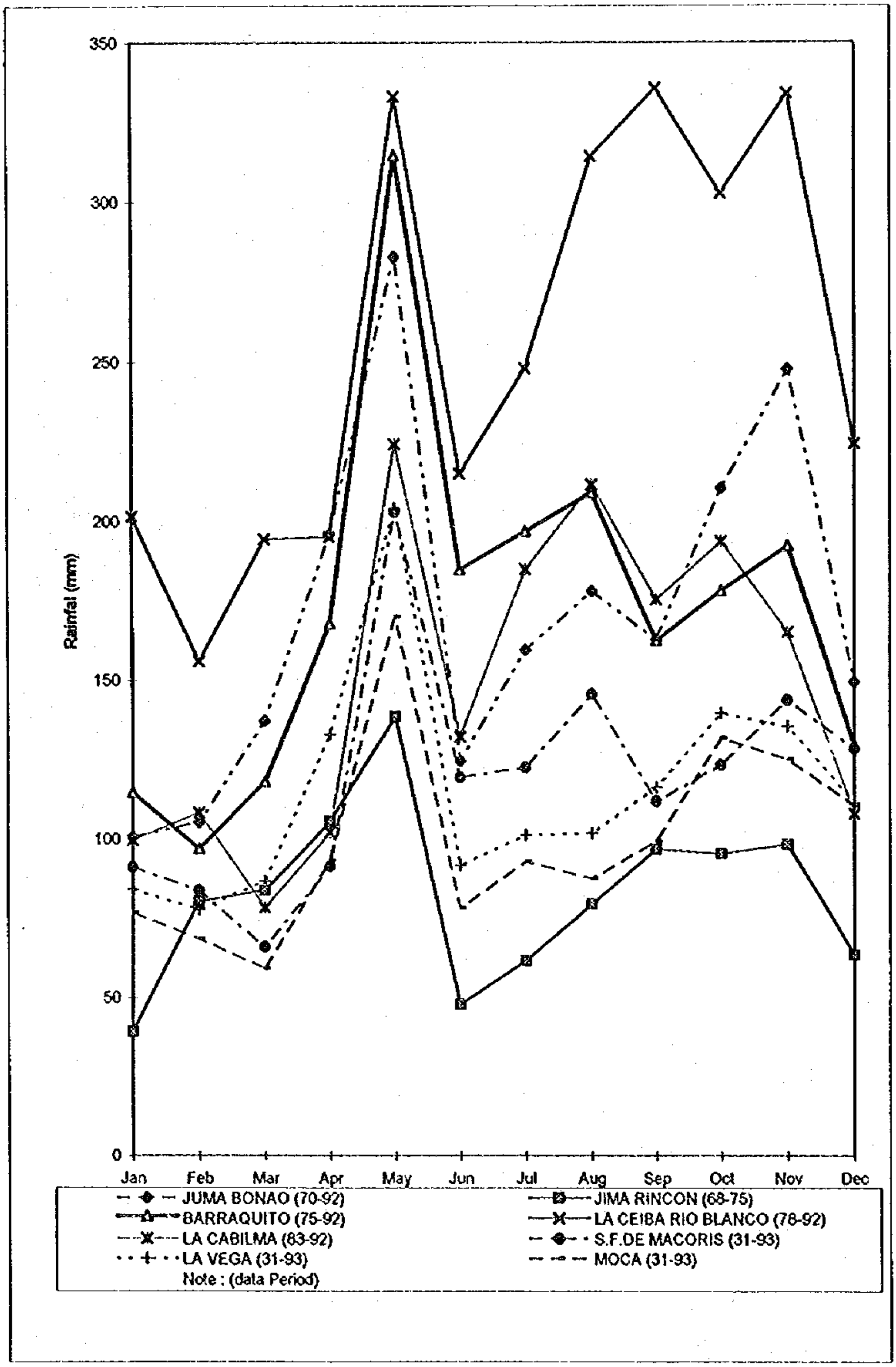


Fig. B.2.2 Typical Rainfall Pattern in the Yuna River Basin

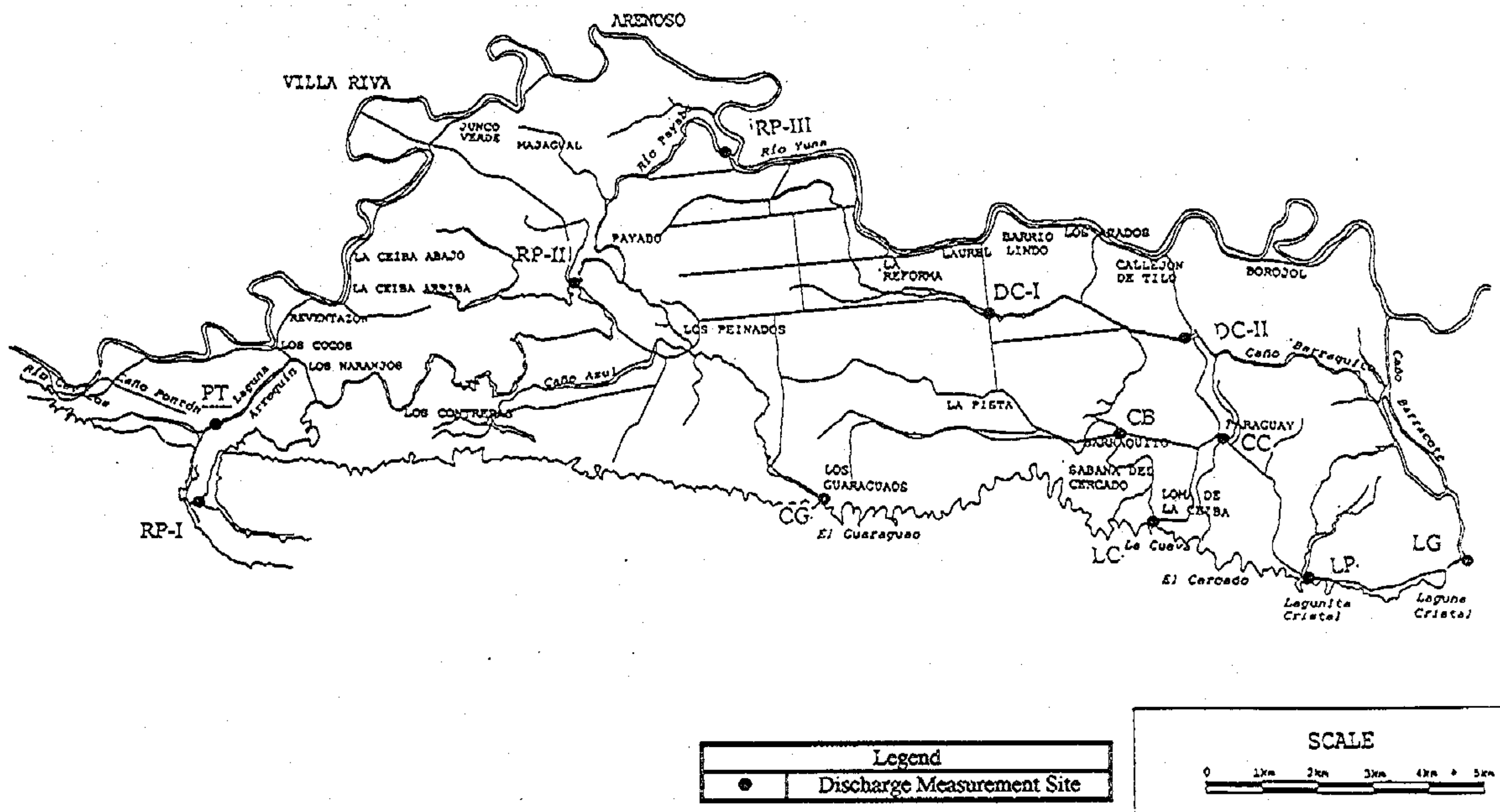


Fig. B.2.3 Location of Discharge Measurement in the Study Area

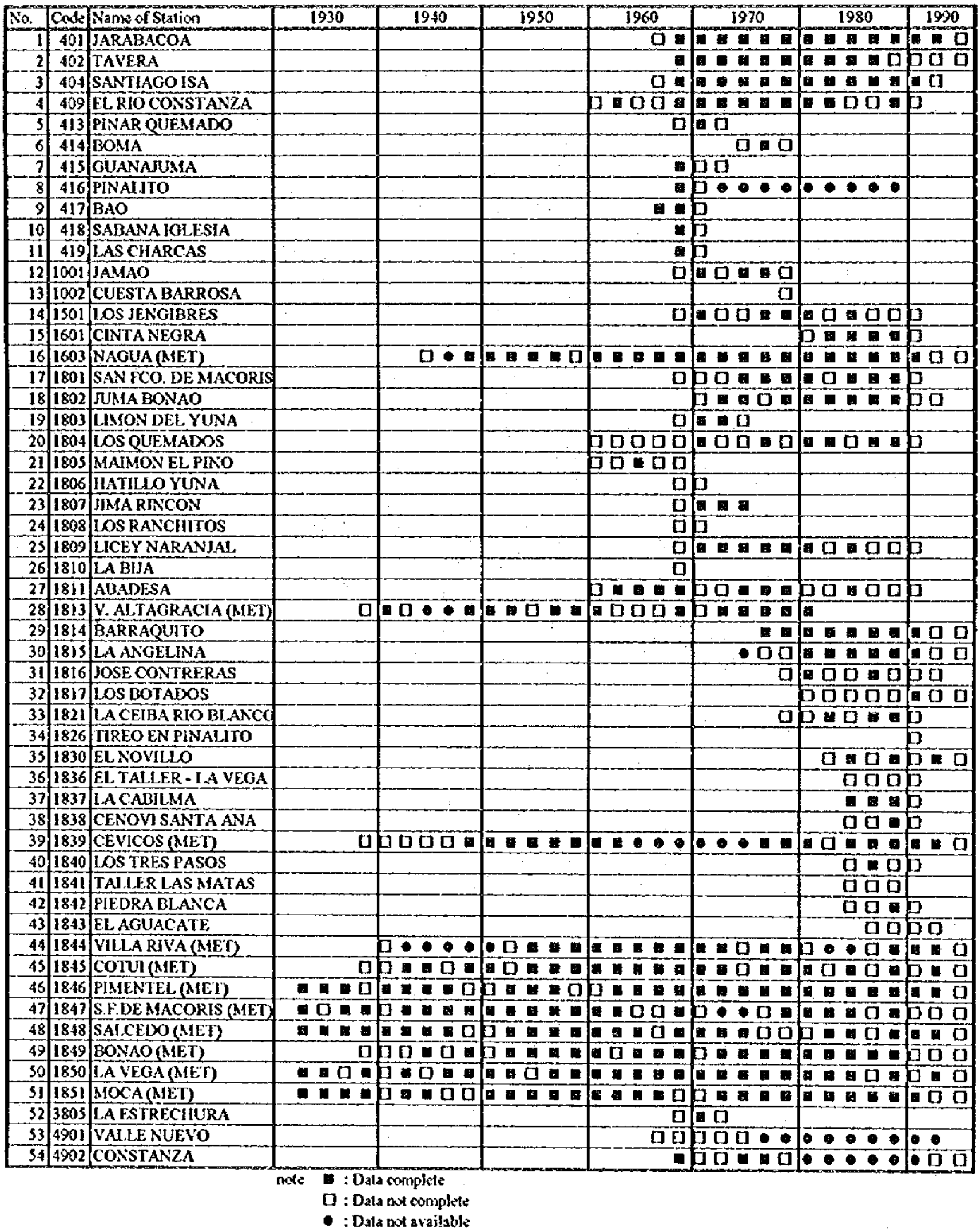


Fig. B.3.1 Bar Chart of Data Continuity (1/3)
(1) Rainfall Data

(2) Relative Humidity

No.	Code	Name of Station	1960			1970										1980										1990				
1	401	JARABACOA	●	●	●	●	●	●	■	□	□	■	■	■	□	□	■	■	□	■	■	□	□	□	□	□	■	■	■	□
2	402	TAVERA		●	●	●	●	●	●	□	■	■	■	■	■	■	■	■	□	□	□	□	□	■	□	□	□	□	□	□
3	404	SANTIAGO-ISA	●	●	●	●	●	●	■	■	□	■	□	□	□	■	□	□	□	□	■	□	□	□	□	□	□	□	□	
4	1801	SAN FCO. DE MACORIS		●	●	●	●	●	□	□	□	□	■	□	□	□	□	□	□	□	□	□	□	□	●	●				
5	1802	JUMA-BONAO						●	□	□	□	□	□	□	■	■	■	□	■	□	□	□	□	□	■	□	□	□	□	
6	1803	EL LIMON			●	●	●	●	□	□	●																			
7	1806	HATILLO - YUNA			●	●	●																							
8	1814	BARRAQUITO										■	■	□	■	■	■	□	□	□	□	□	□	□	□	□	■	□	□	□
9	1815	LA ANGELINA								●	●	●	□	□	□	□	■	□	□	□	□	□	■	■	■	■	■	□	□	●
10	1816	JOSE CONTRERAS													□	□	■	□	□	■	■	□	□	□	■	□	●	□	□	
11	1817	LOS BOTADOS															□	□	□	□	□	□	■	□	■	■	■	□	□	●
12	1830	EL NOVILLO																	□	□	□	□	□	□	□	□	□	■	□	□
13	1843	EL AGUACATE																					□	□	□	●	●	□		
14	4901	VALLE NUEVO	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
15	4902	CONSTANZA		●	●	●	●	●	●	□	□	■	■	□	□	●	●	●	●	●	●	●	●	●	●	●	●	□	□	□

(3) Temperature

No.	Code	Name of Station	1960			1970										1980										1990				
1	401	JARABACOA	□	■	■	■	■	□	■	□	□	■	■	■	□	□	■	■	□	■	■	□	□	□	□	□	■	■	■	□
2	402	TAVERA		■	■	□	■	□	●	□	■	■	■	■	■	■	■	■	□	□	□	□	□	■	□	□	□	□	□	□
3	404	SANTIAGO-ISA	□	□	□	■	□	■	■	■	□	■	□	□	□	■	□	□	□	□	■	□	□	□	□	□	□	□	□	
4	1801	SAN FCO. DE MACORIS		□	□	□	□	□	□	□	□	□	■	□	□	□	□	□	□	□	□	□	□	□	●	●				
5	1802	JUMA-BONAO						■	□	□	□	□	□	□	■	■	■	□	■	□	□	□	□	□	■	□	□	□	□	
6	1803	EL LIMON			■	■	■	□	□	□	●																			
7	1806	HATILLO - YUNA			□	□	□																							
8	1814	BARRAQUITO										■	■	□	■	■	■	□	□	□	□	□	□	□	□	□	■	□	□	□
9	1815	LA ANGELINA								●	●	●	□	□	□	□	■	□	□	□	□	□	■	■	■	■	■	□	□	●
10	1816	JOSE CONTRERAS													□	□	■	□	□	■	■	□	□	□	■	□	●	□	□	
11	1817	LOS BOTADOS															□	□	□	□	□	□	■	□	■	■	■	□	□	●
12	1830	EL NOVILLO																	□	□	□	□	□	□	□	□	□	■	□	□
13	1843	EL AGUACATE																					□	□	□	●	●	□		
14	4901	VALLE NUEVO	□	□	□	□	□	□	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
15	4902	CONSTANZA		■	■	□	□	□	●	□	□	■	■	□	□	●	●	●	●	●	●	●	●	●	●	●	●	□	□	□

(4) Evaporation

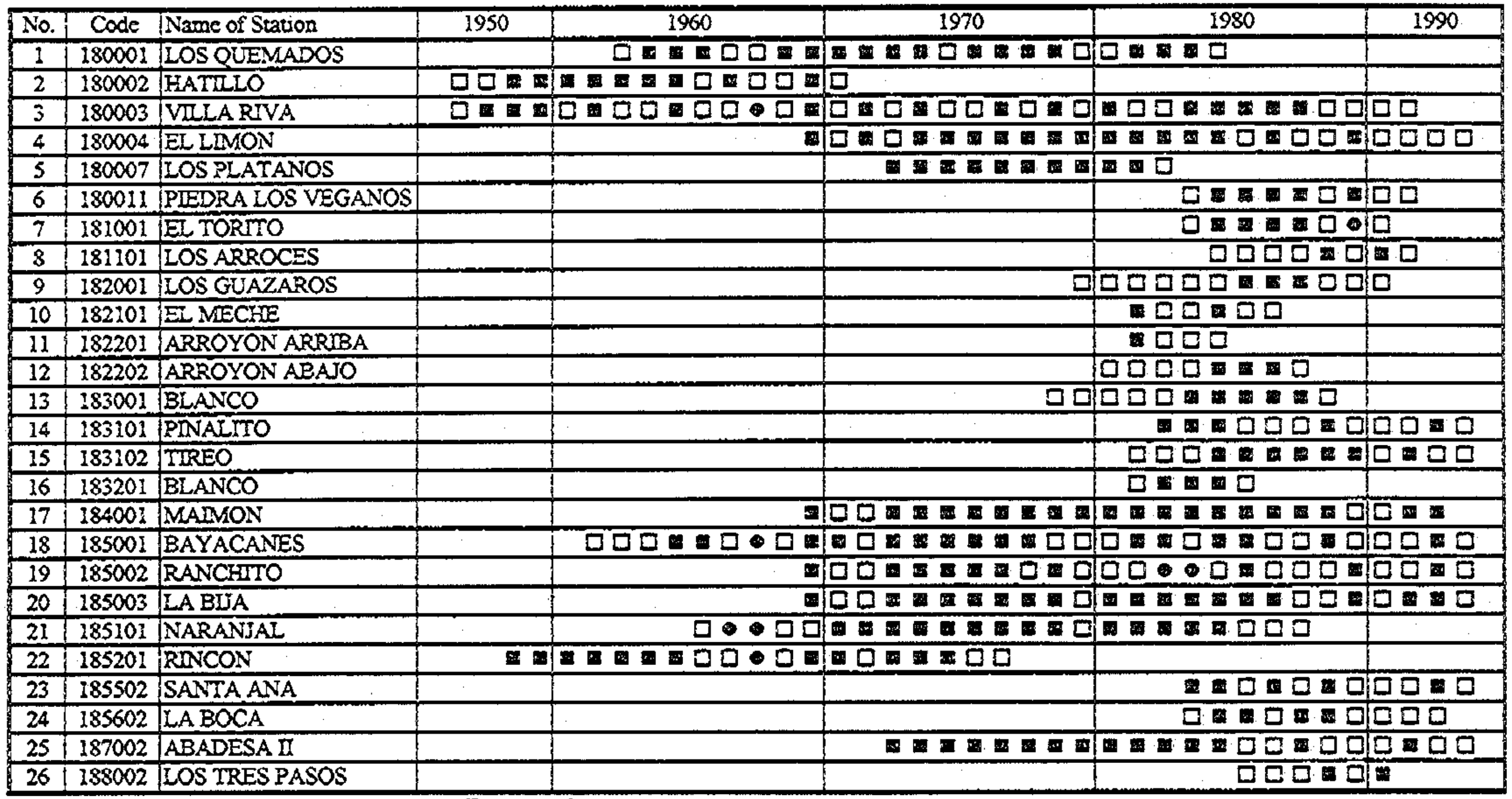
No.	Code	Name of Station	1960			1970										1980										1990				
1	401	JARABACOA	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	●	●	□	□
2	402	TAVERA		□	□	□	□	□	●	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
3	404	SANTIAGO-ISA	●	□	□	□	□	□	●	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	
4	1801	SAN FCO. DE MACORIS		□	□	□	●	□	●	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□				
5	1802	JUMA-BONAO						□	●	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	
6	1803	EL LIMON			□	□	□	□	□	□	●																			
7	1806	HATILLO - YUNA			●	●	□																							
8	1814	BARRAQUITO										□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	●
9	1815	LA ANGELINA								●	●	●	●	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	●
10	1816	JOSE CONTRERAS													□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	
11	1817	LOS BOTADOS															□	□	□	□	□	□	□	□	●	□	□	□	□	●
12	1830	EL NOVILLO																	□	□	●	●	●	□	□	□	□	□	□	□
13	1843	EL AGUACATE																					●	□	●	●	●	●		
14	4901	VALLE NUEVO	●	●	□	●	□	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	□	
15	4902	CONSTANZA		□	□	□	□	□	□	□	□	□	□	□	□	●	●	●	●	●	●	●	●	●	●	●	●	□	□	□

(5) Wind Velocity

No.	Code	Name of Station	1960			1970										1980										1990				
8	1814	BARRAQUITO									□	□	□	□		□	■	□		□	□	□	□	□	□	□	□	□	□	●

note ■ : Data complete □ : Data not complete ● : Data not available

Fig. B.3.1 Bar Chart of Data Continuity (2/3)



note ■ : Data complete
□ : Data not complete
● : Data not available

Fig. B.3.1 Bar Chart of Data Continuity (3/3)
(6) Hydrological Data

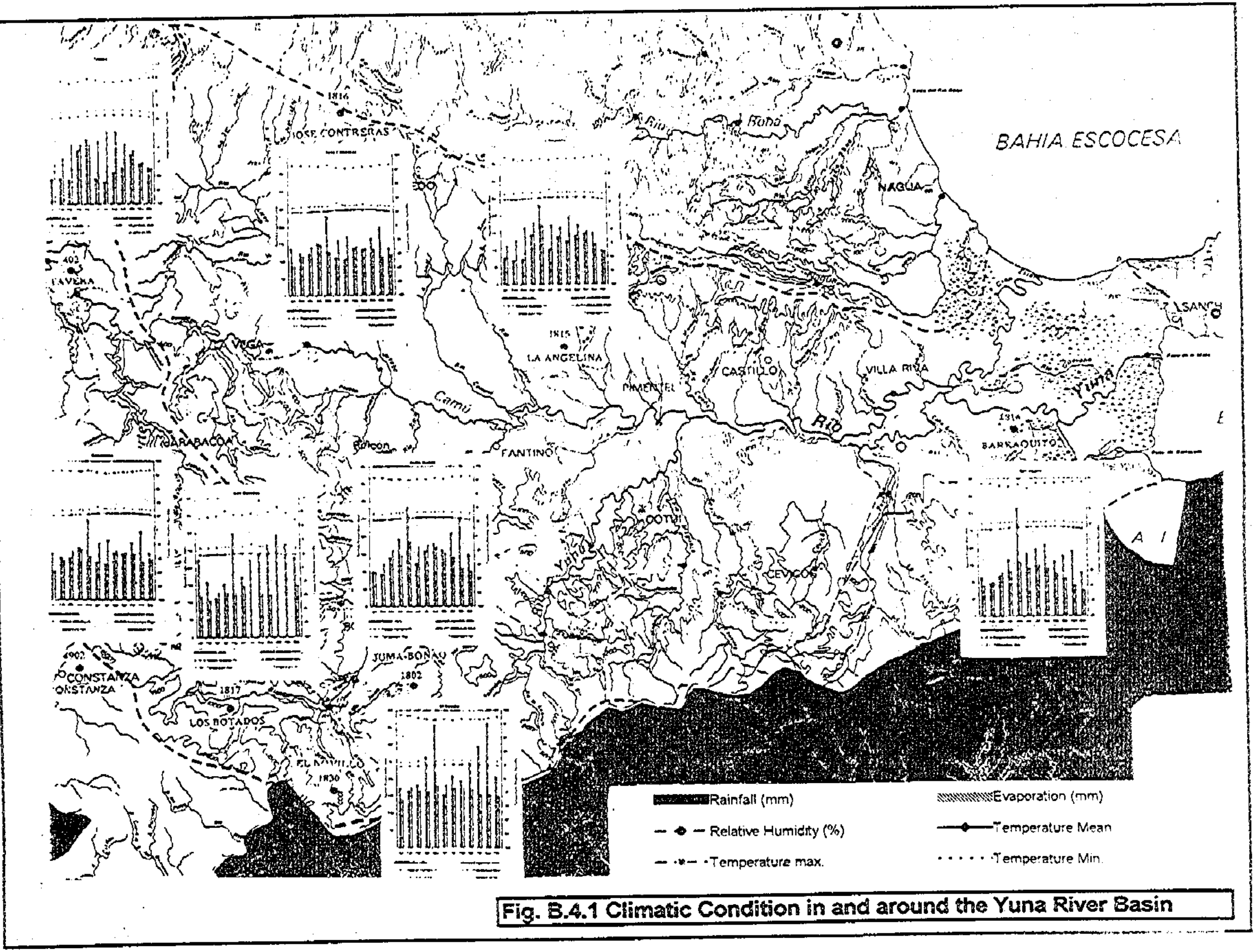
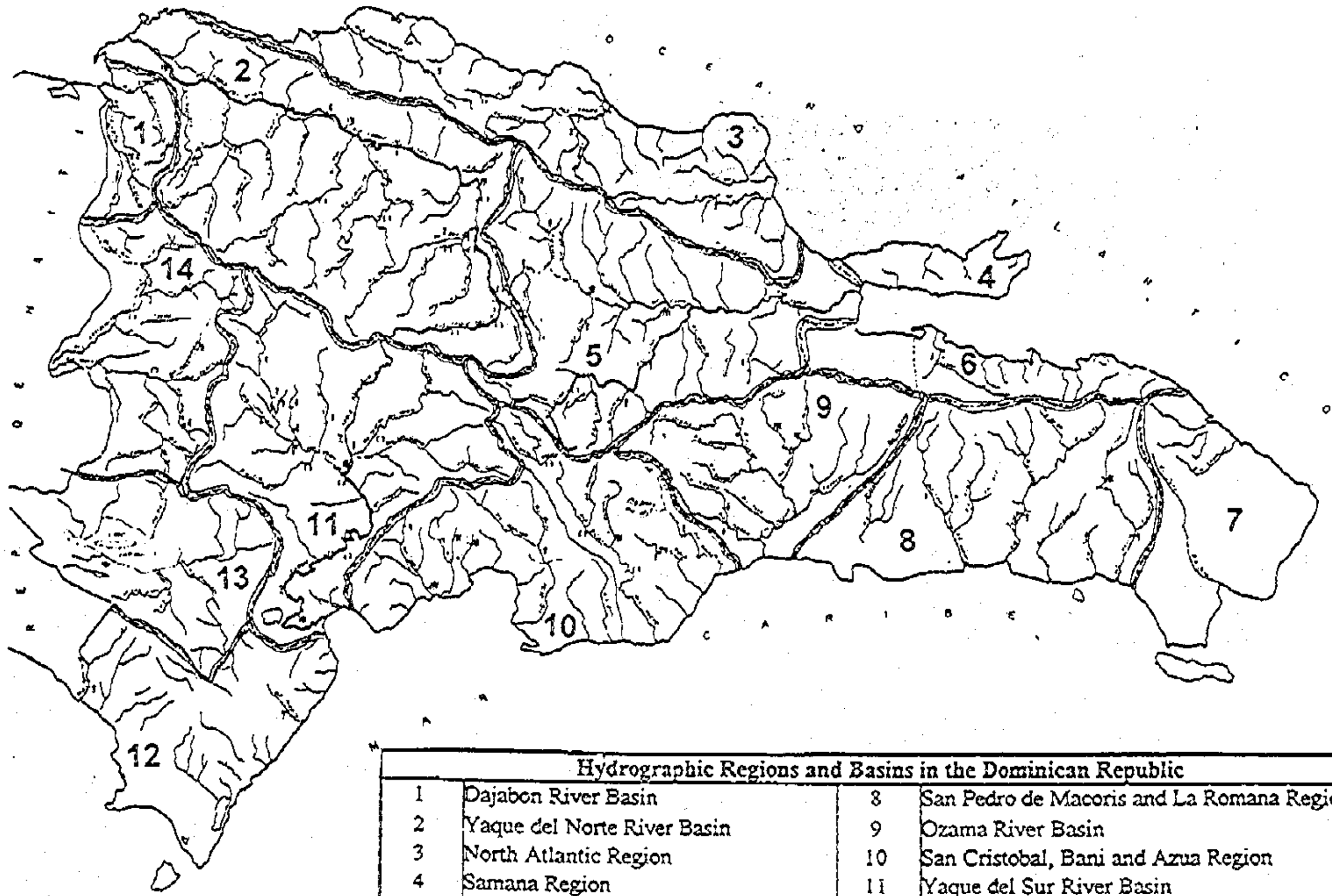


Fig. B.4.1 Climatic Condition in and around the Yuna River Basin



Hydrographic Regions and Basins in the Dominican Republic			
1	Dajabon River Basin	8	San Pedro de Macoris and La Romana Region
2	Yaque del Norte River Basin	9	Ozama River Basin
3	North Atlantic Region	10	San Cristobal, Bani and Azua Region
4	Samana Region	11	Yaque del Sur River Basin
5	Yuna River Basin	12	Bahoruco Region
6	Miches and Sabana de la Mar Region	13	Lake Enriquillo Region
7	Higuey Region	14	Artibonito River Basin

Fig. B.5.1 Drainage System in Dominican Republic

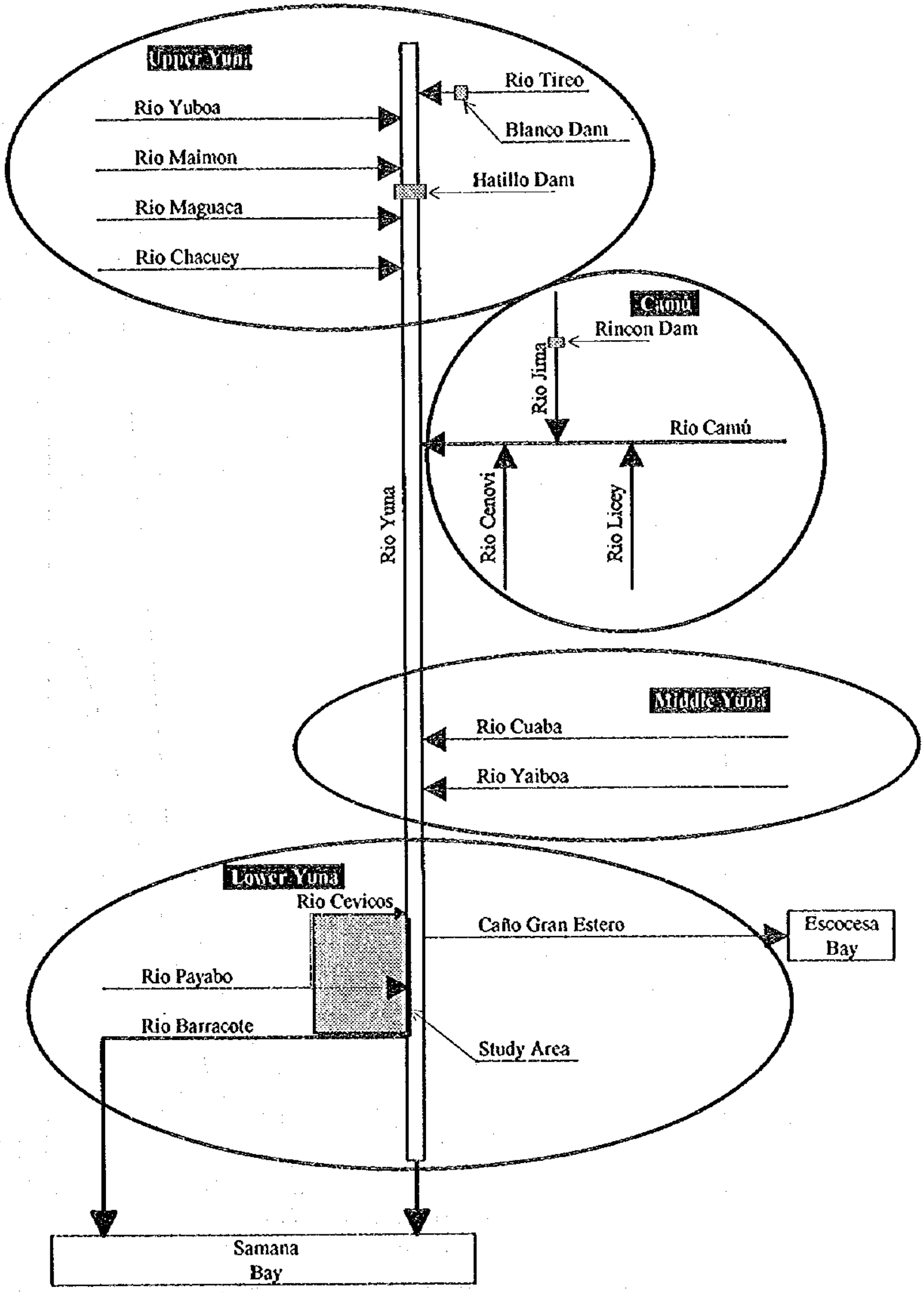


Fig. B.5.2 Drainage System in the Yuna River Basin

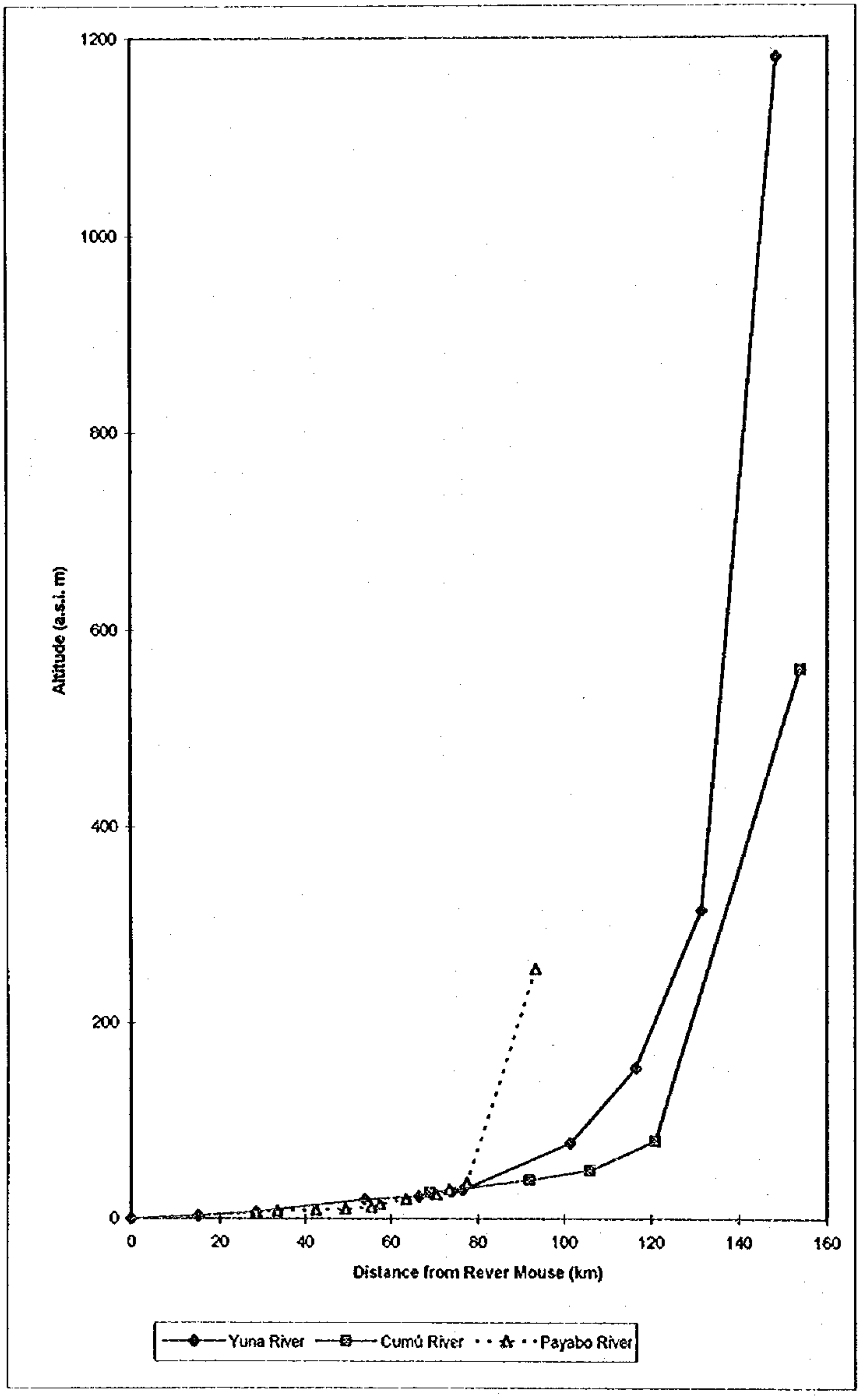


Fig. B.5.3 Longitudinal Profile the Yuna, Camu and Payabo River

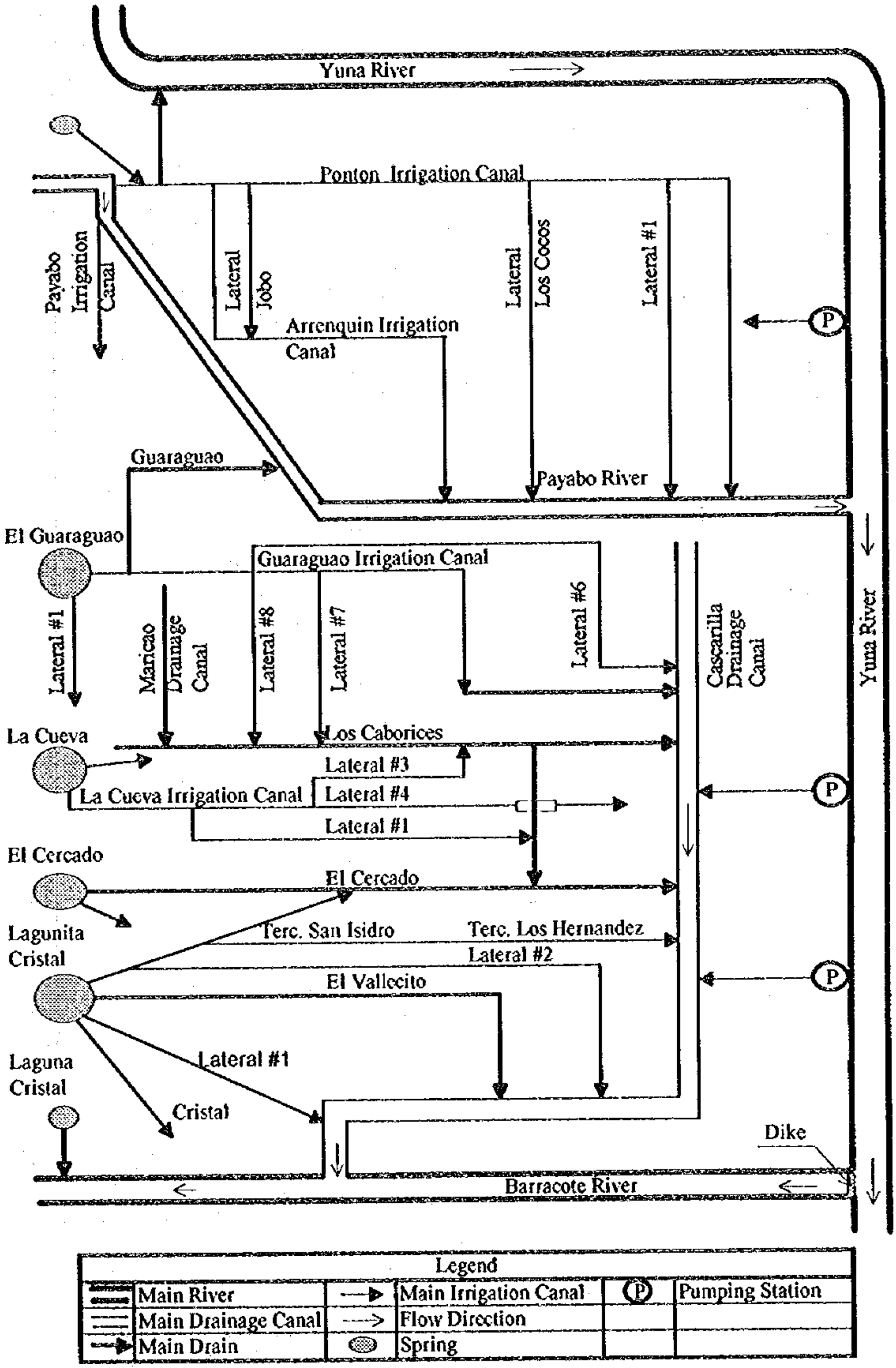


Fig. B.5.4 Drainage Condition in the Study Area

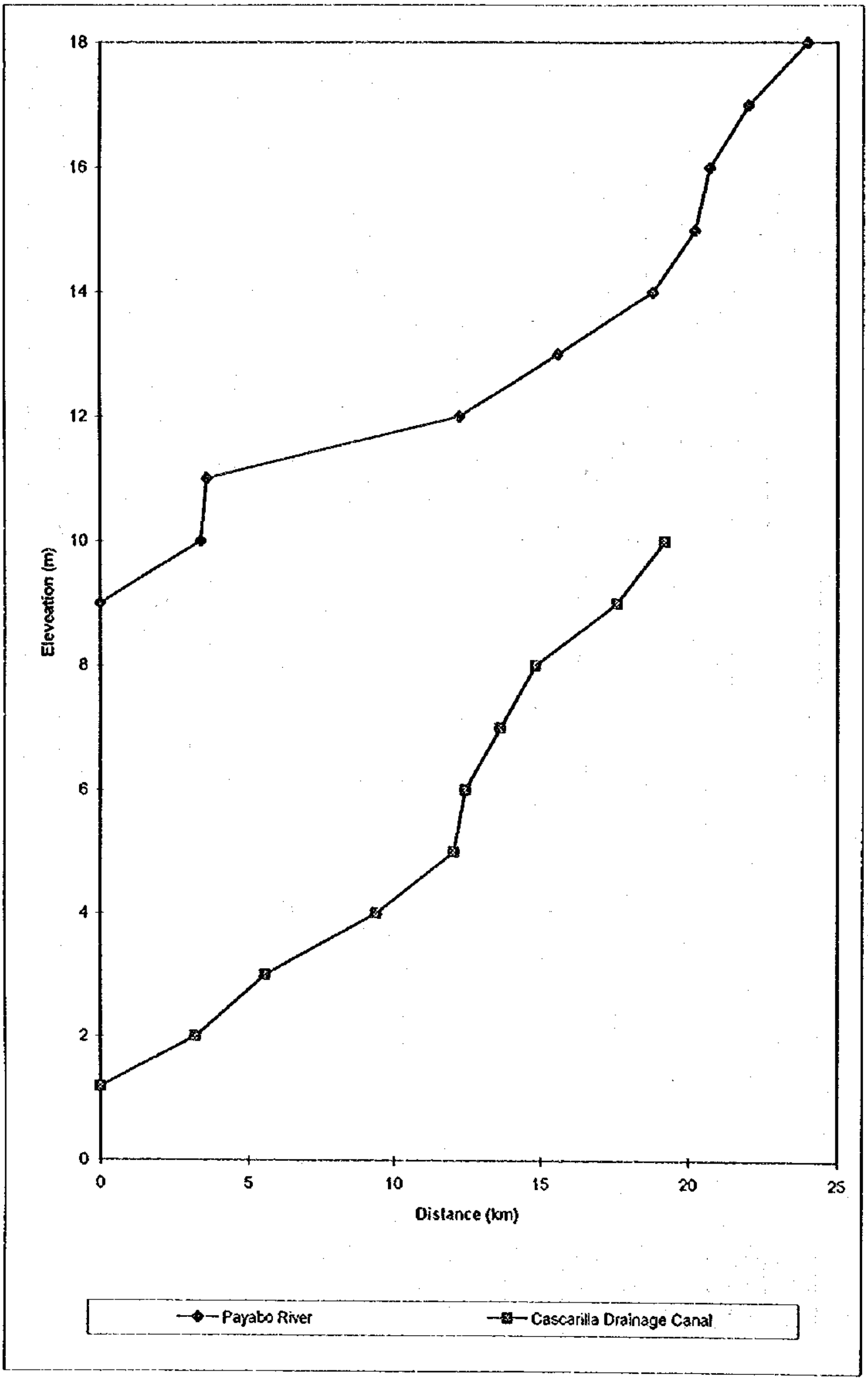
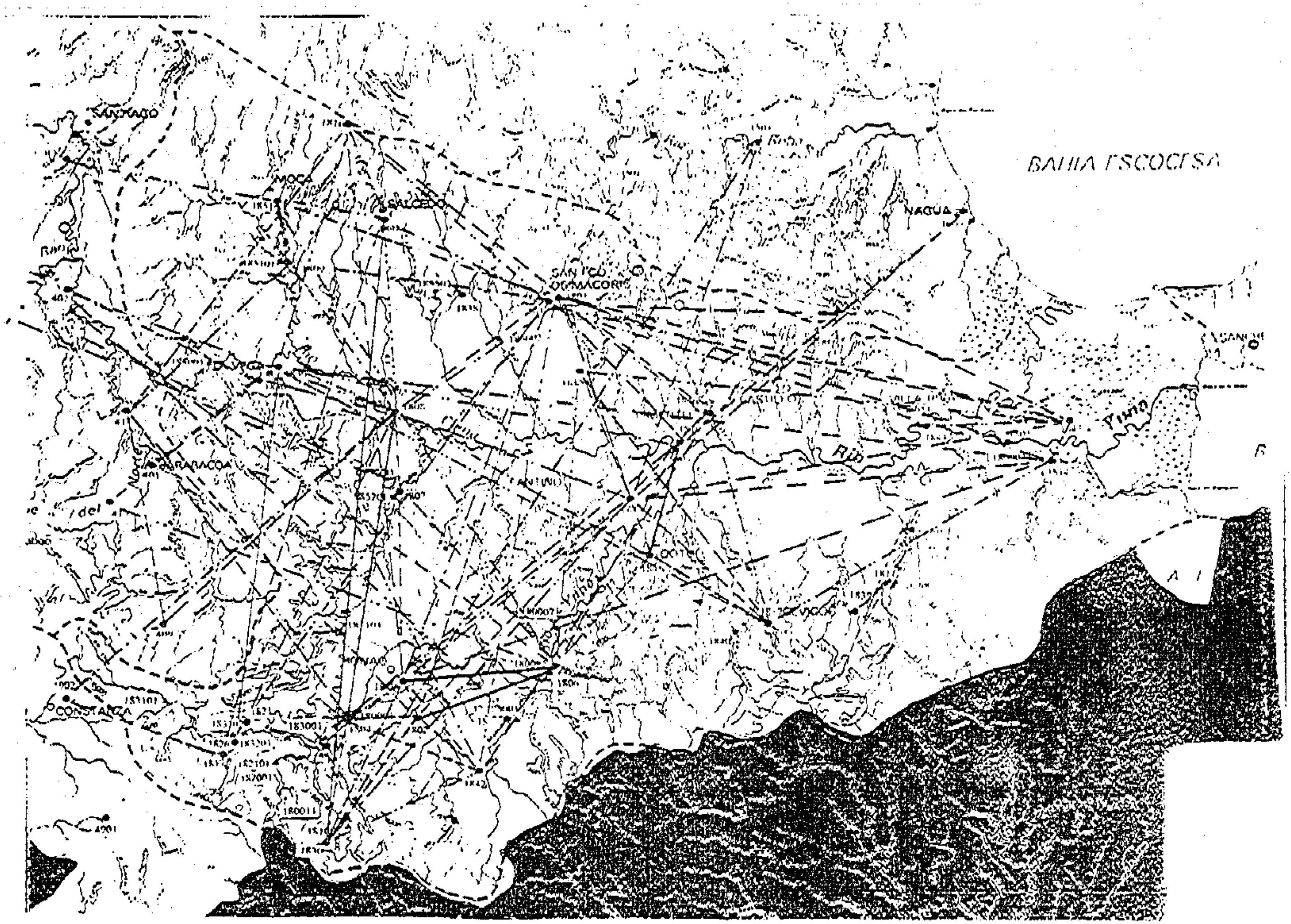


Fig. B.5.5 Profile of the Payabo River and the Cascarilla Canal in the Study Area



Correlationship for Monthly Rainfall Correlation Coeficient "r"	
————	r>90%
– – – – –	80%<r<89%
–·–·–·–	r>75%

Fig. B.5.6 Correlationship of Monthly Rainfall

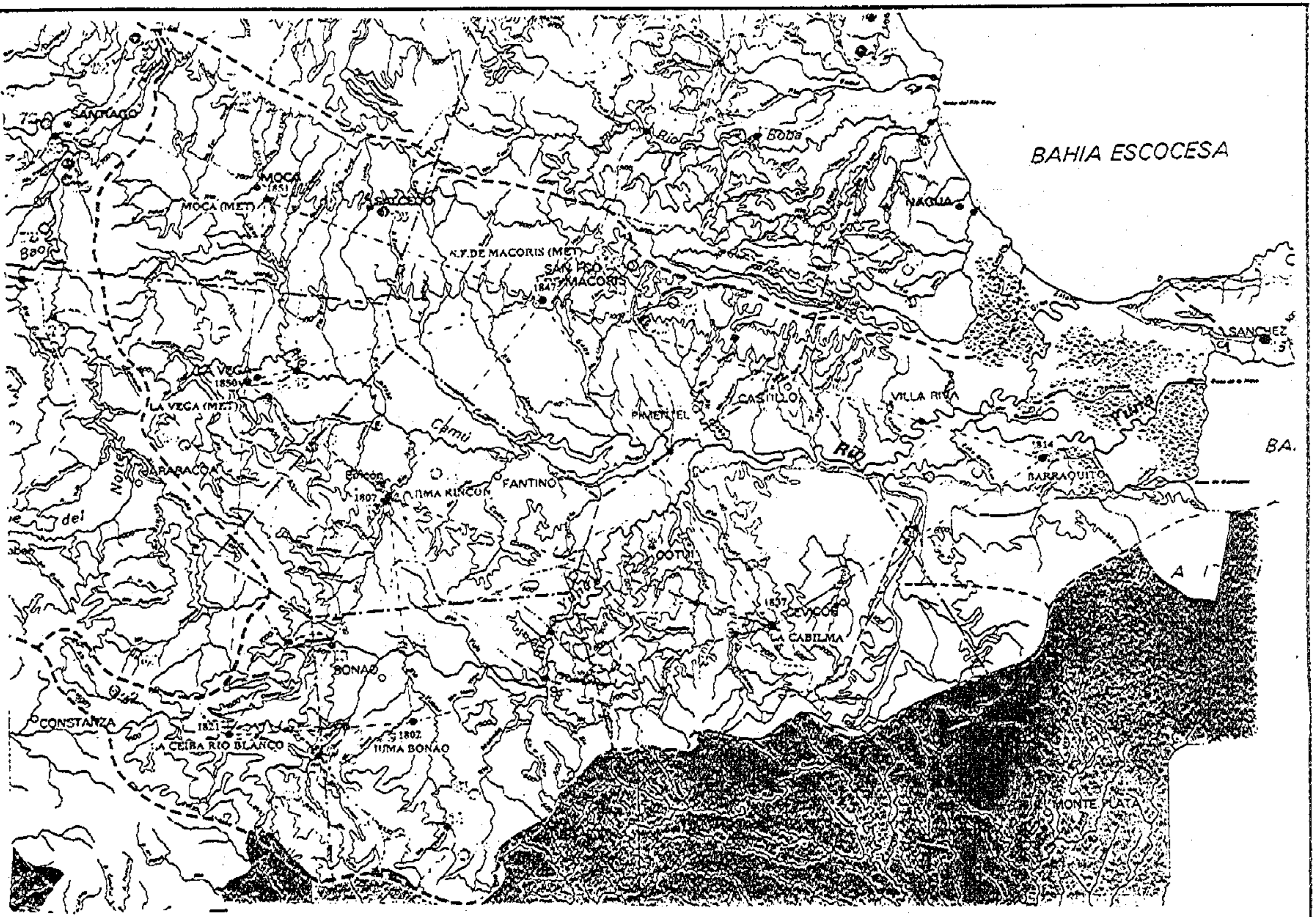


Fig. B.5.7 Thiesen Polygons of the Yuna River Basin

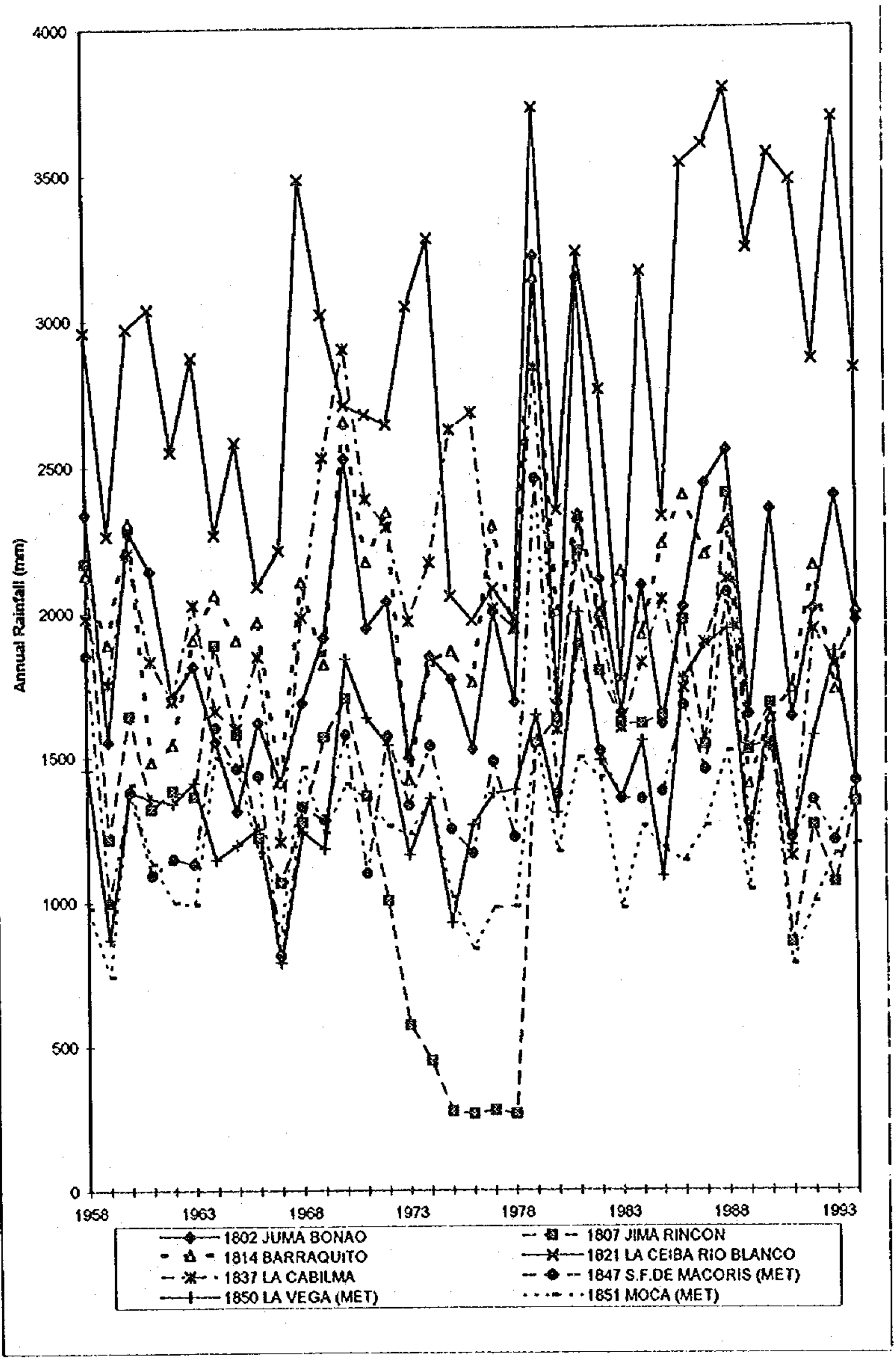


Fig. B.5.8 Annual Rainfall at Selected Stations
from 1958 to 1993

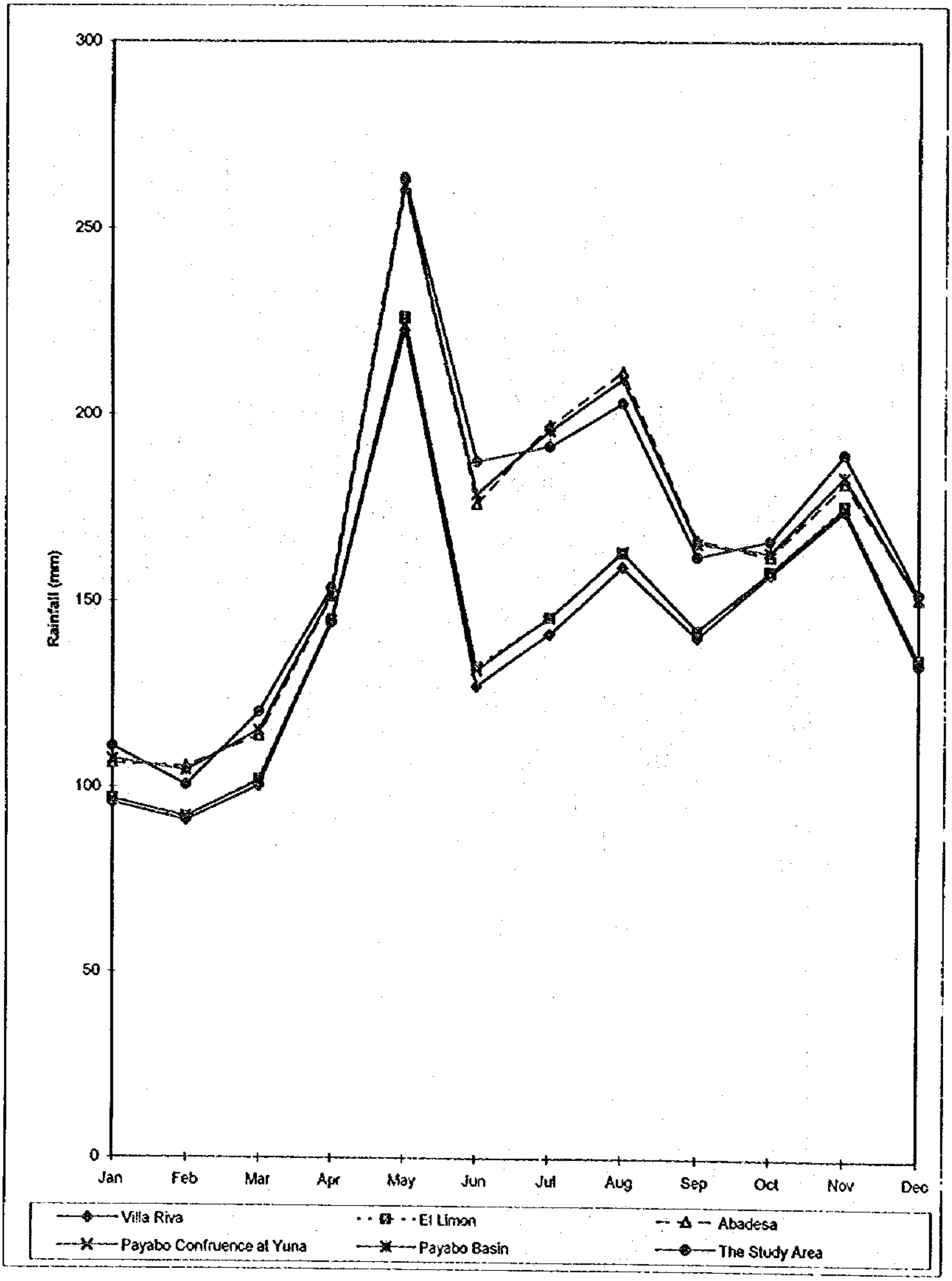


Fig. B.5.9 Estimated Rainfall Patterm

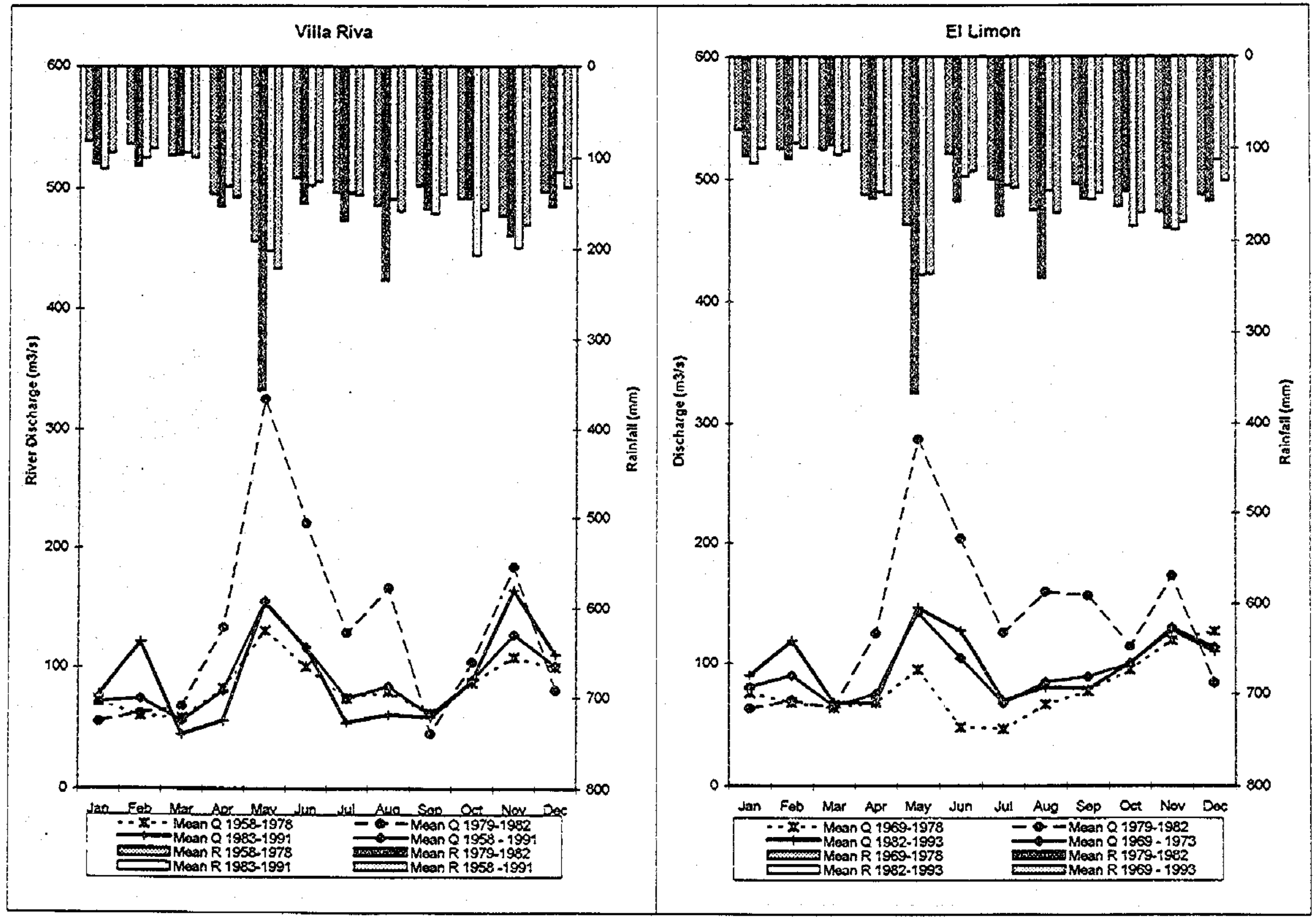


Fig. B.5.10 Water Balance in the Yuna River Basin

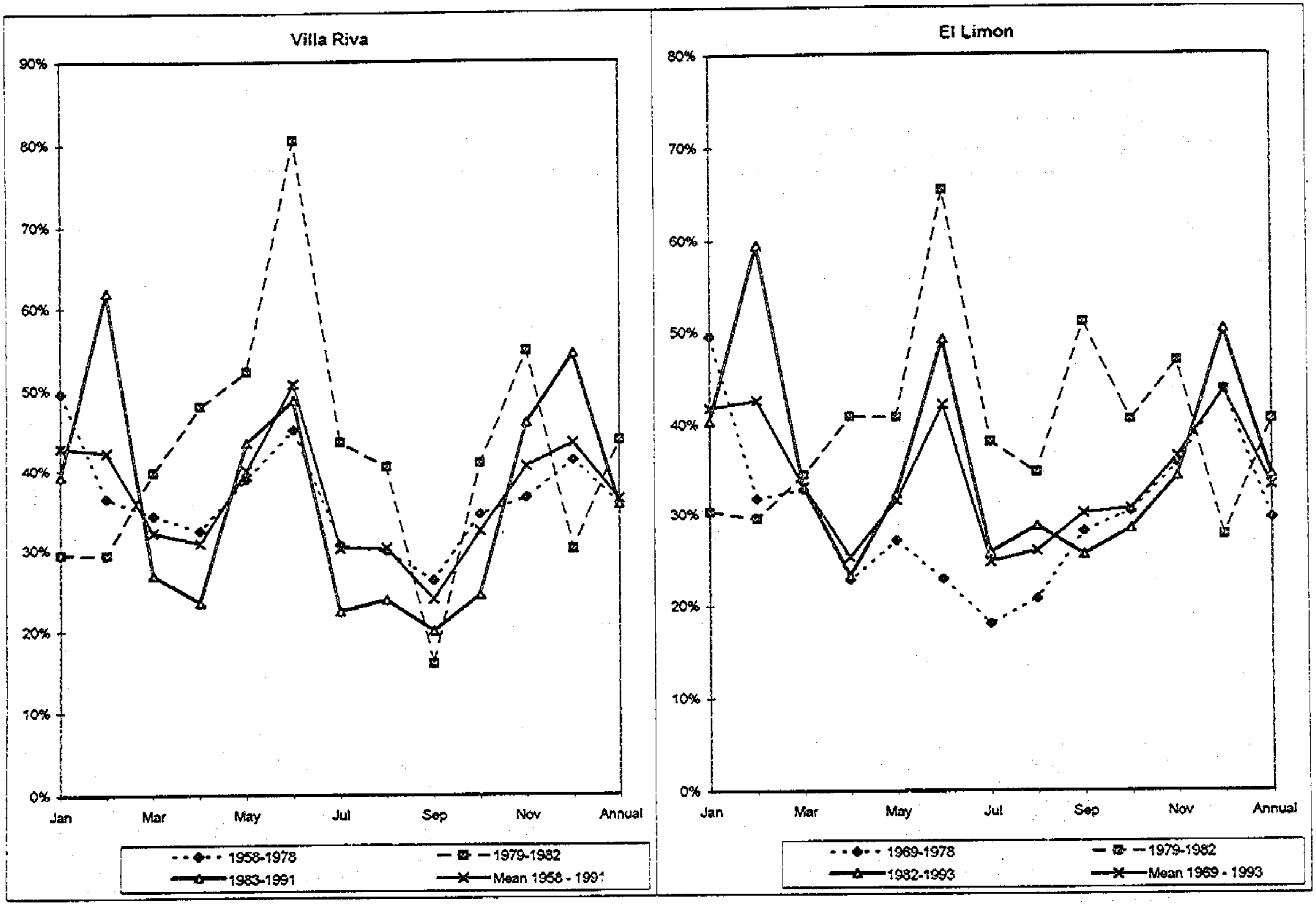


Fig. B.5.11 Runoff Coefficient at Villa Riva and El Limon

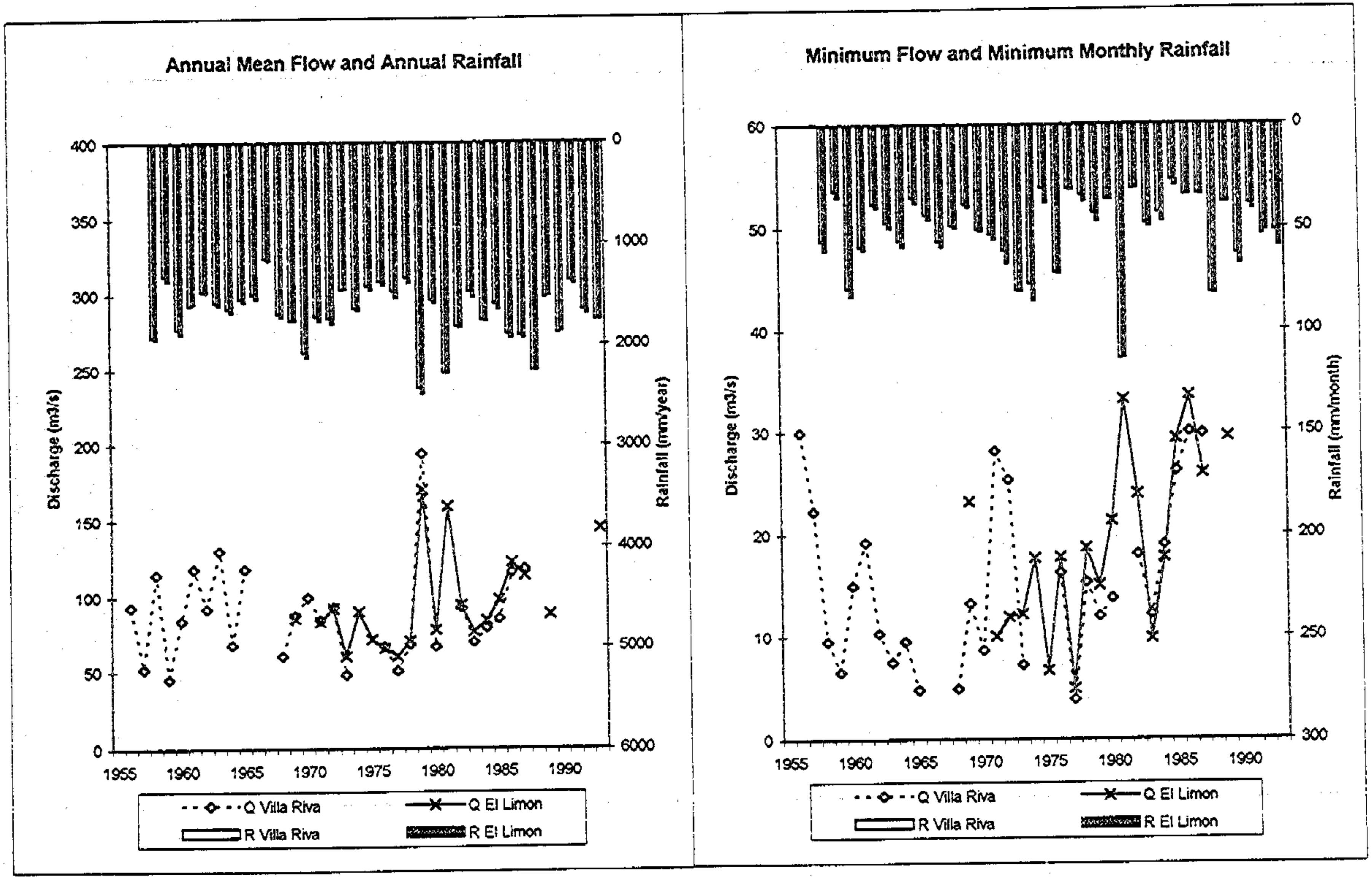


Fig. B.5.12 Annual Mean and Minimum Flow at Villa Riva and El Limon

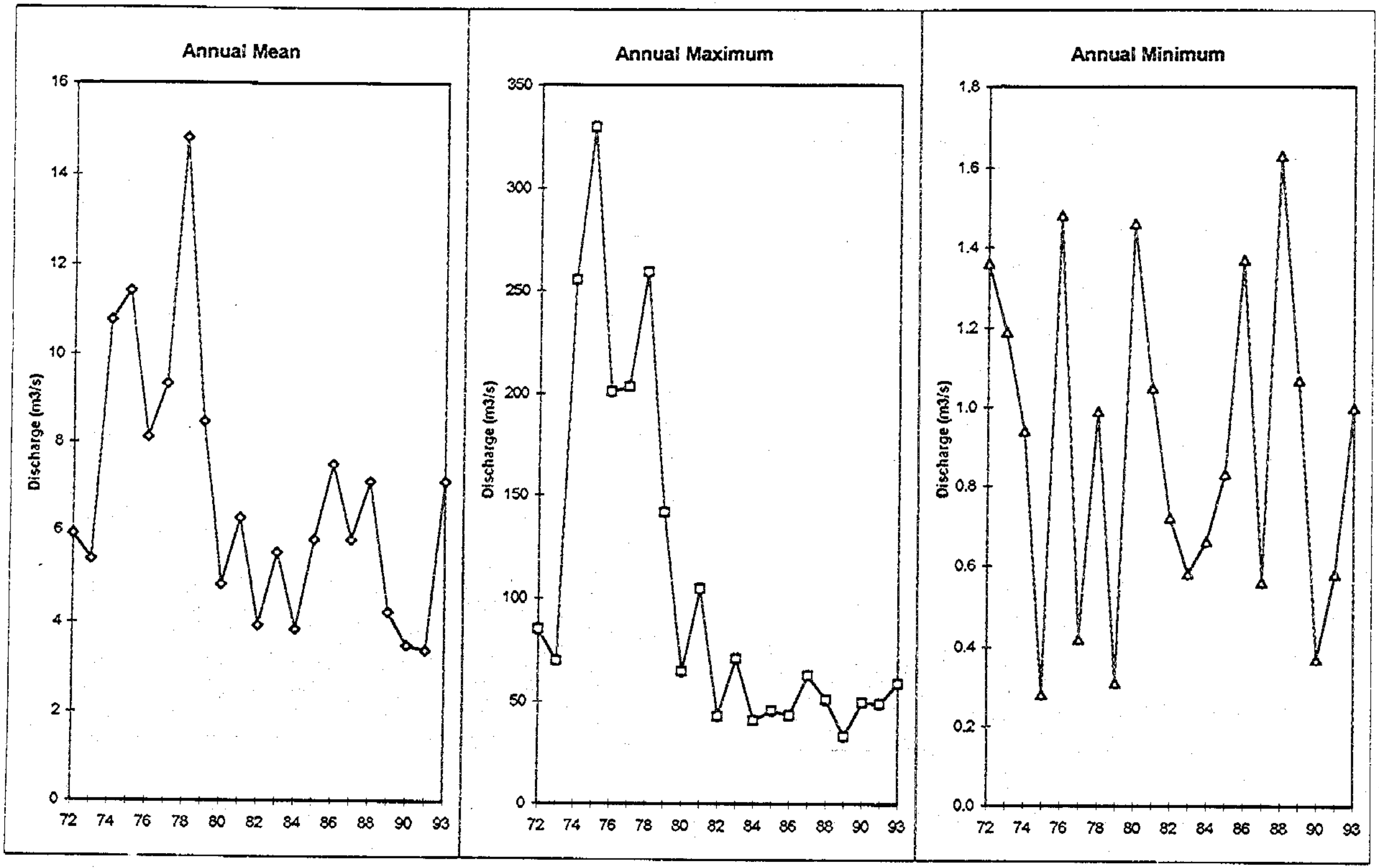


Fig. B.5.13 Discharge at Abadesa

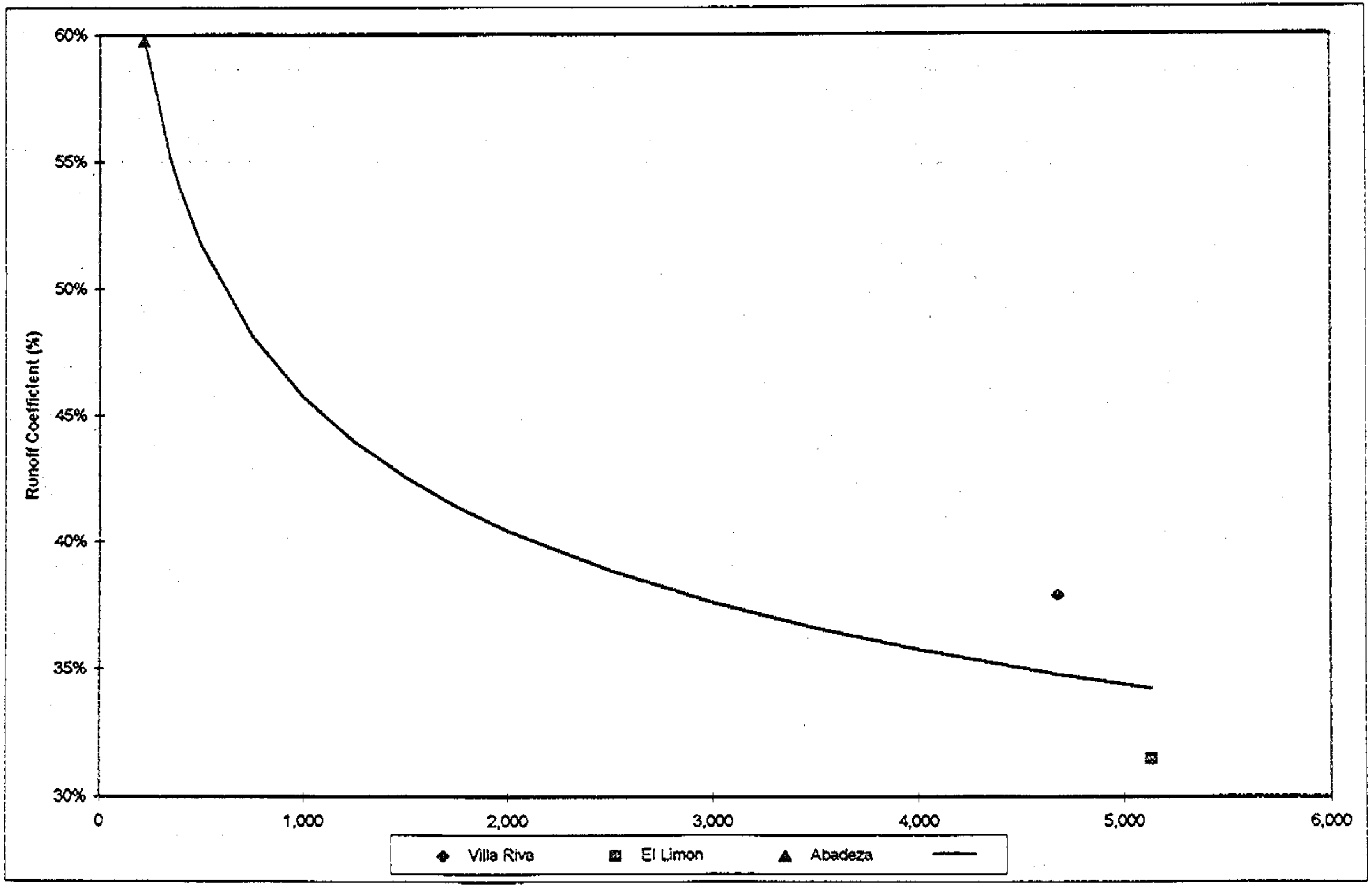


Fig. B.5.14 Relationship Betweeen Runoff Coefficient and Catchment Area

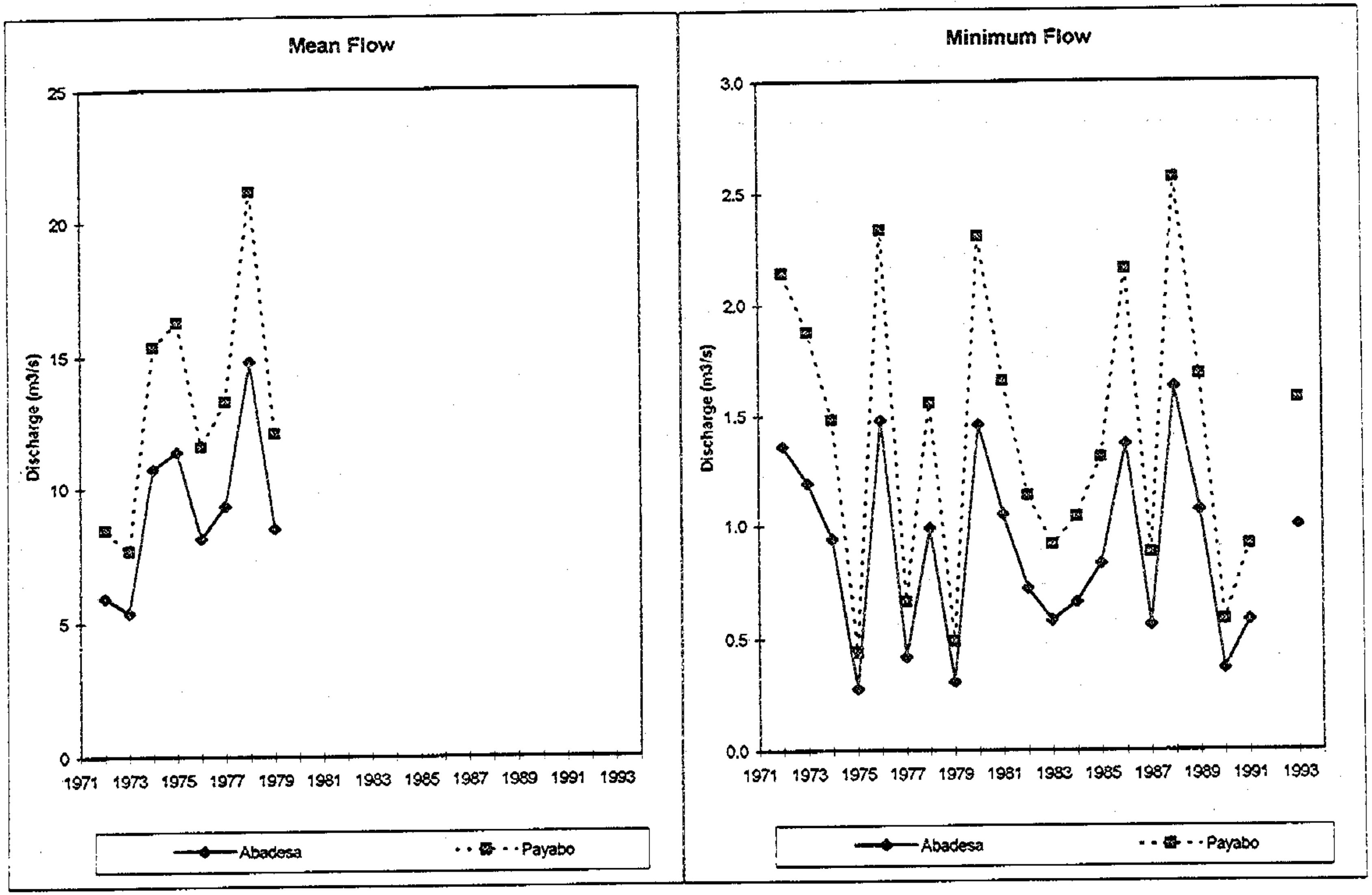


Fig. B.5.15 Estimated Discharge of the Payabo River

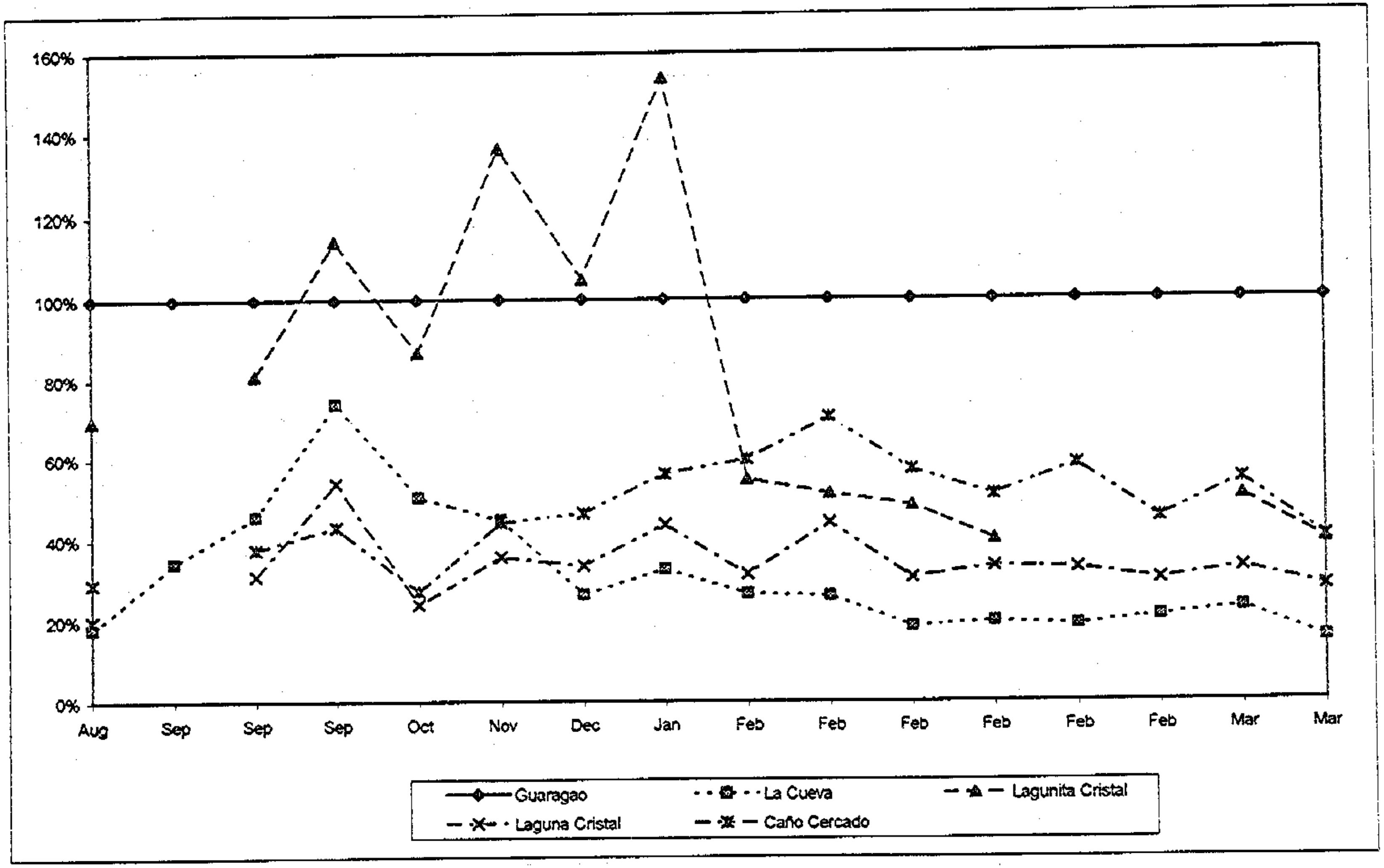


Fig. B.5.16 Portion of Spring Discharge against Guaraguao

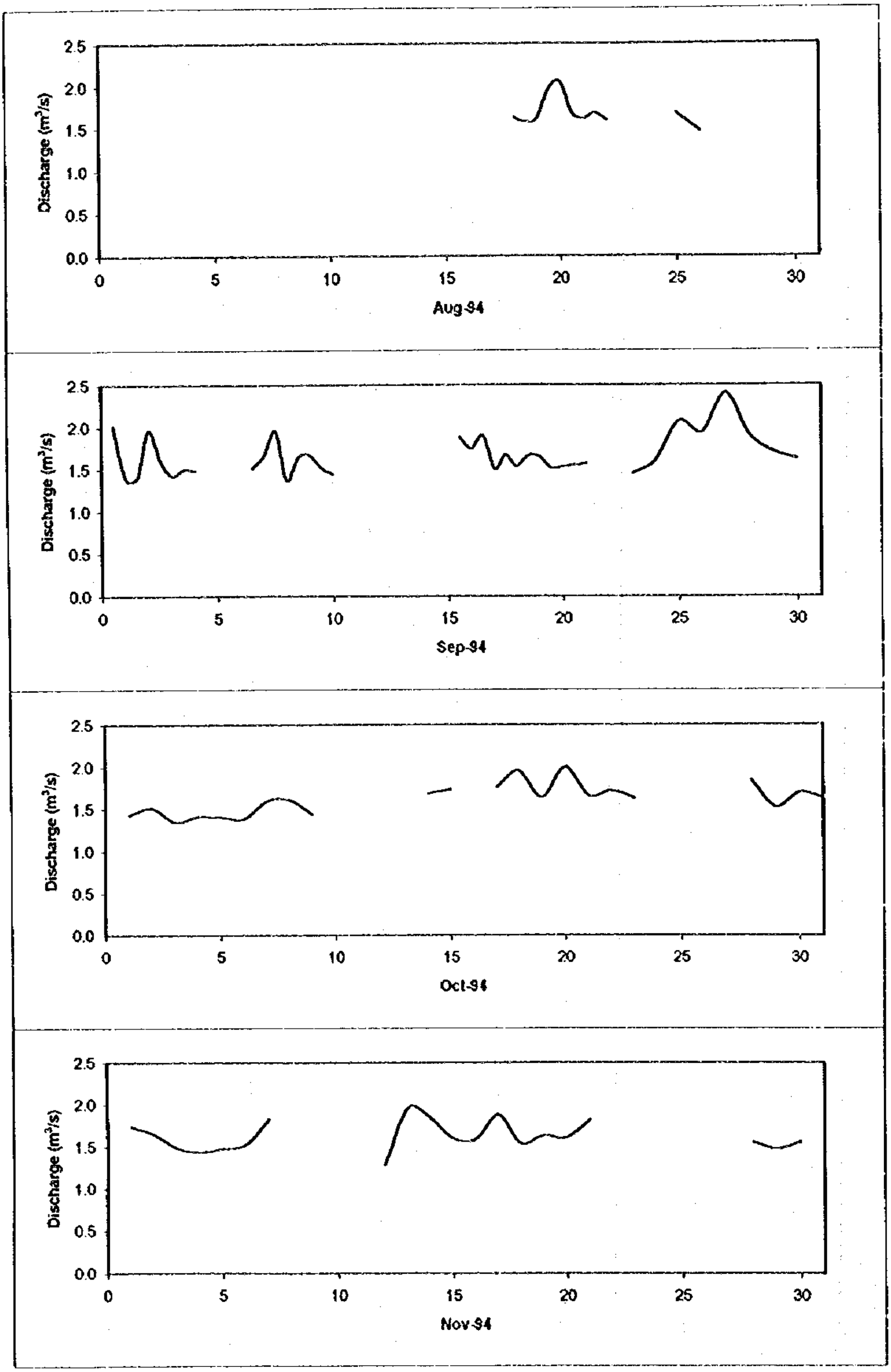


Fig. B.5.17 Spring Discharge at Guaraguao (1/2)

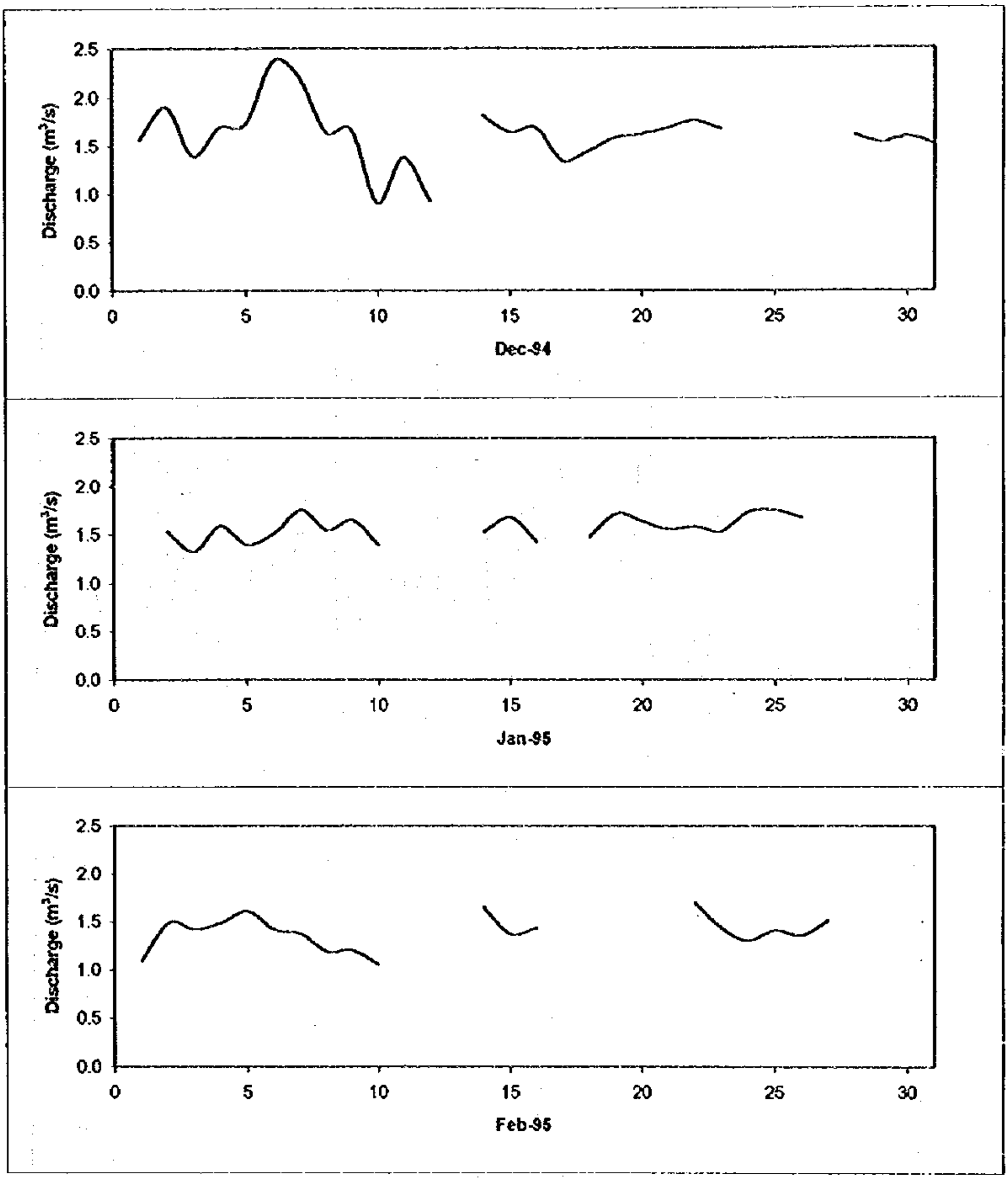


Fig. B.5.17 Spring Discharge at Guaraguao (2/2)

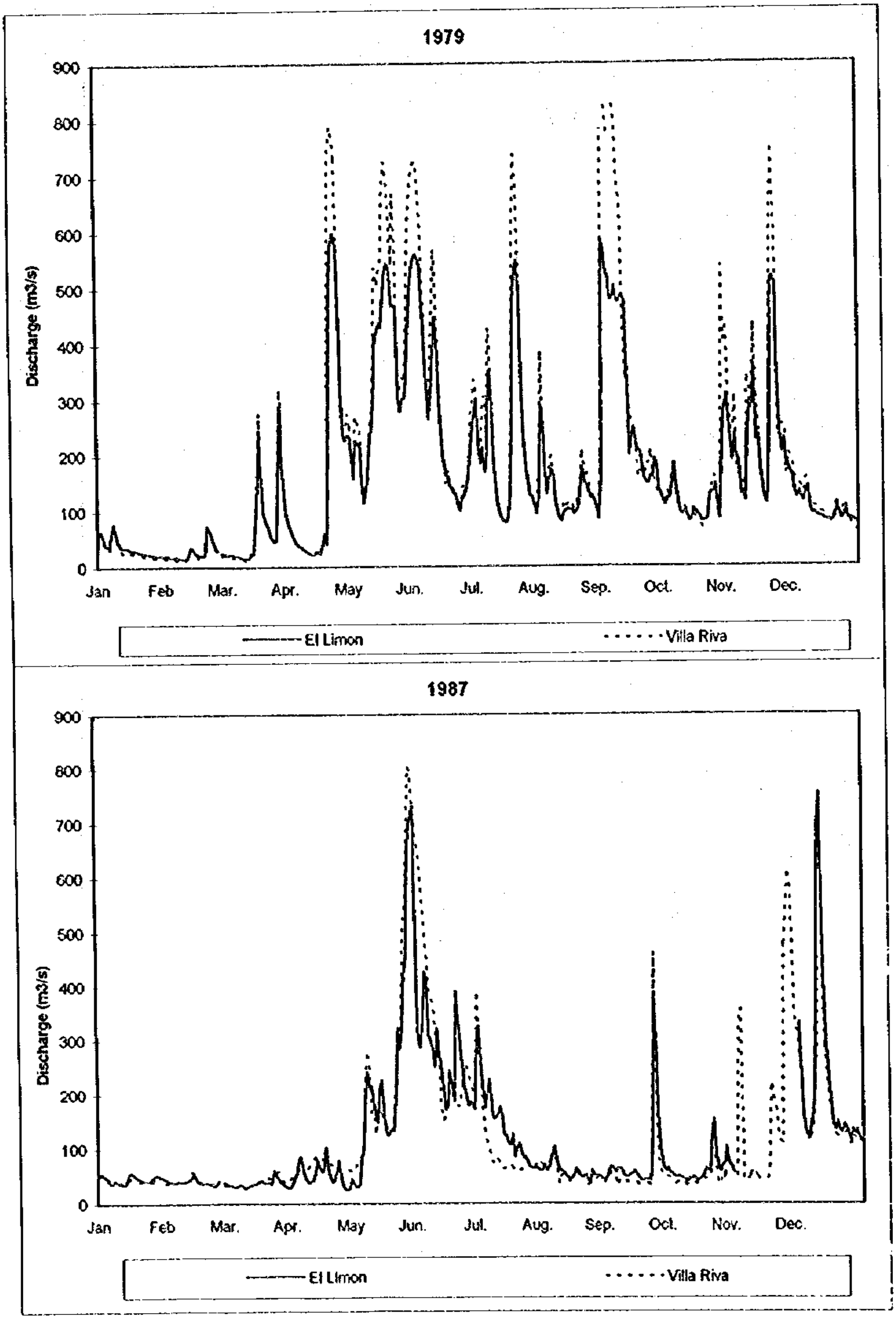


Fig. B.5.18 Daily Mean Discharge at Villa Riva and El Limon

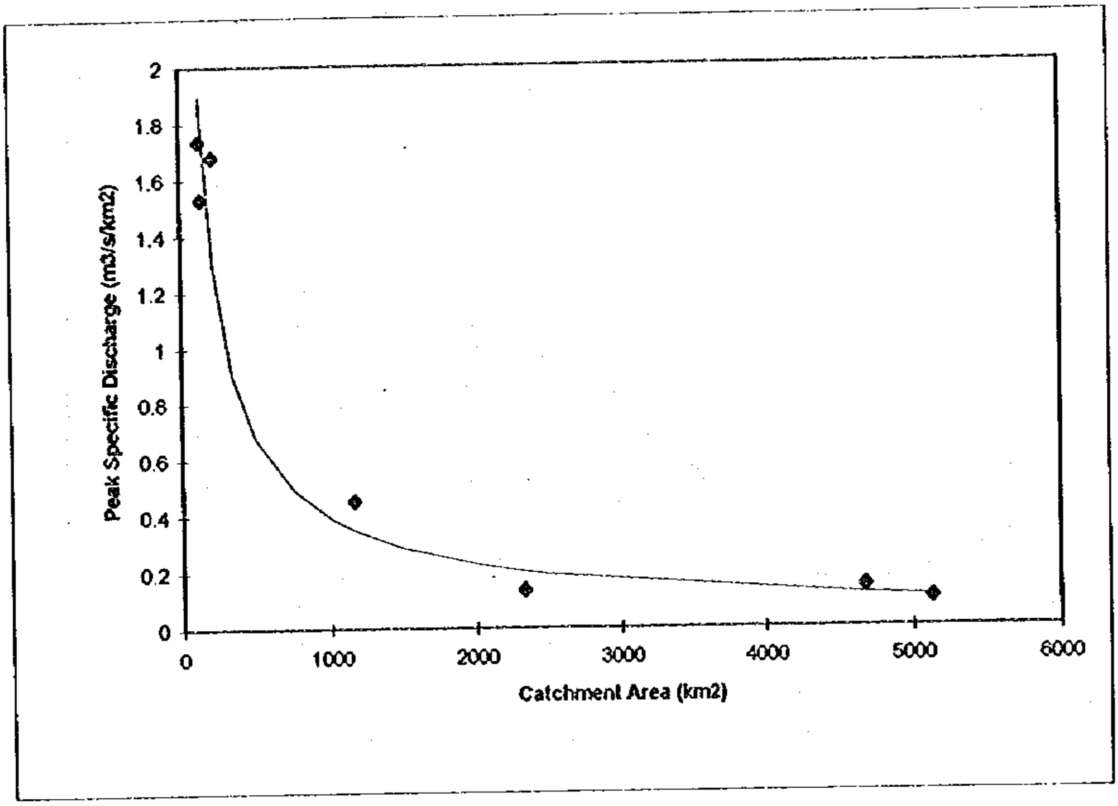


Fig. B.5.19 Specific Discharge and Catchment Area in Flood Period

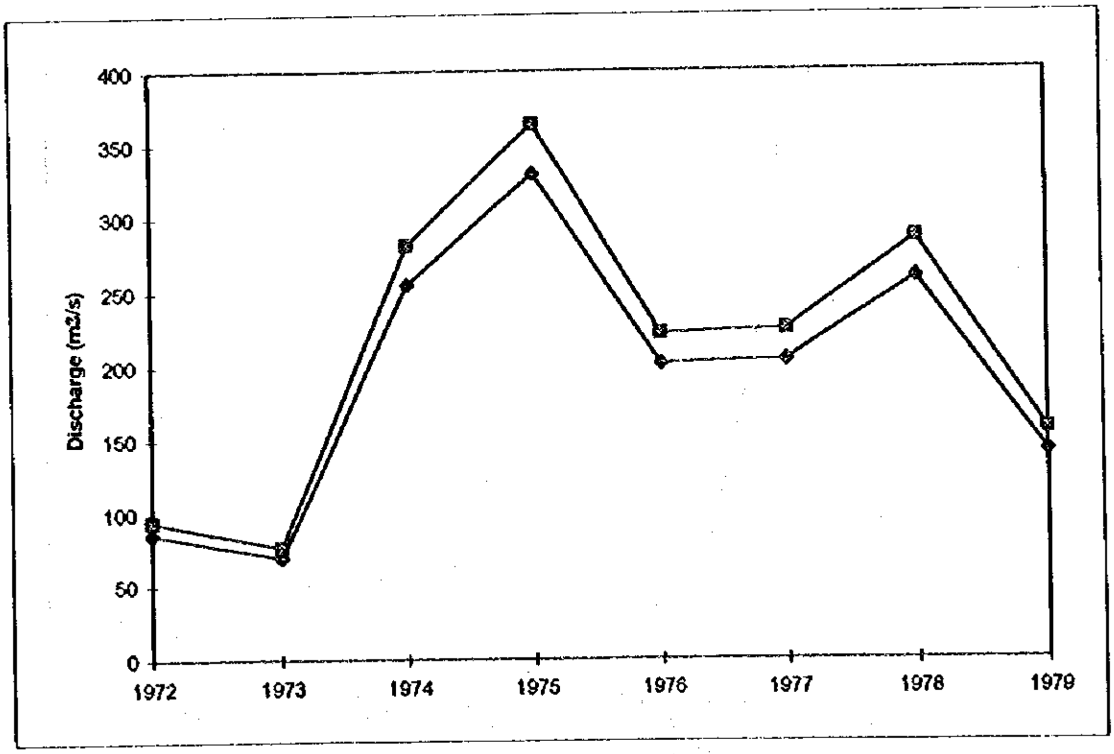


Fig. B.5.20 Estimated Discharge at the Payabo River

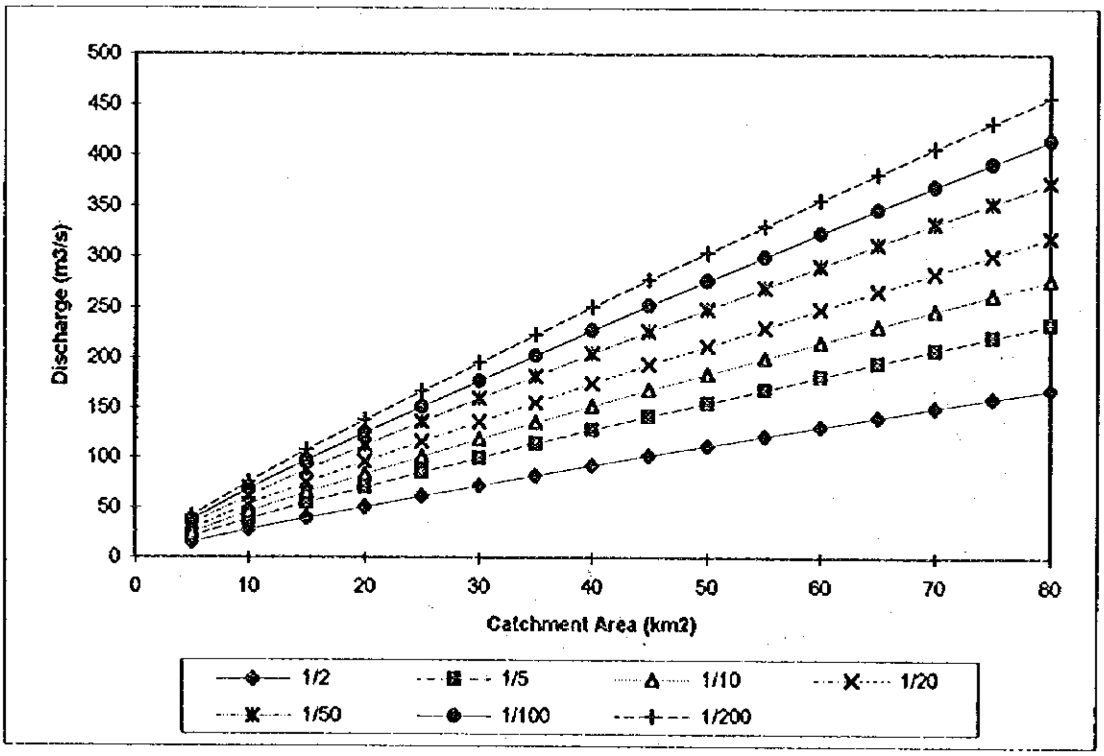


Fig. B.5.21 Relationship between Peak Flood Discharge and Catchment Area

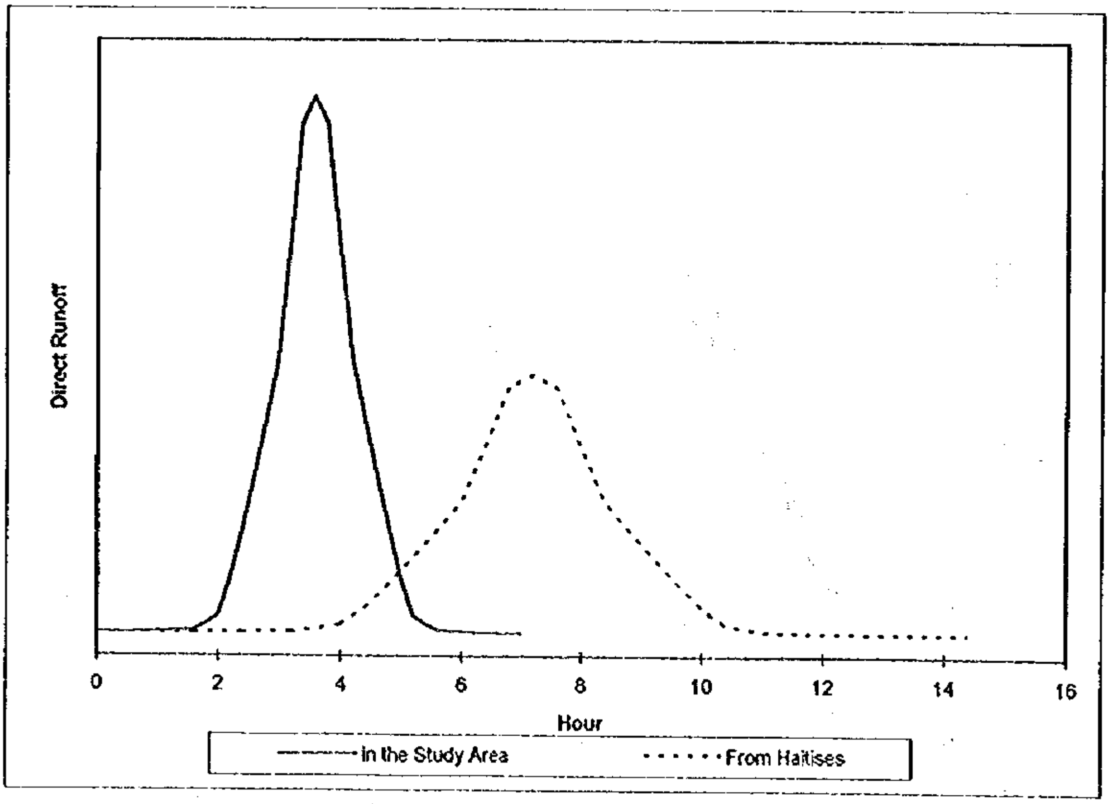


Fig. B.5.22 Relationship of Direct Runoff between the Study Area and Haitises Mountain

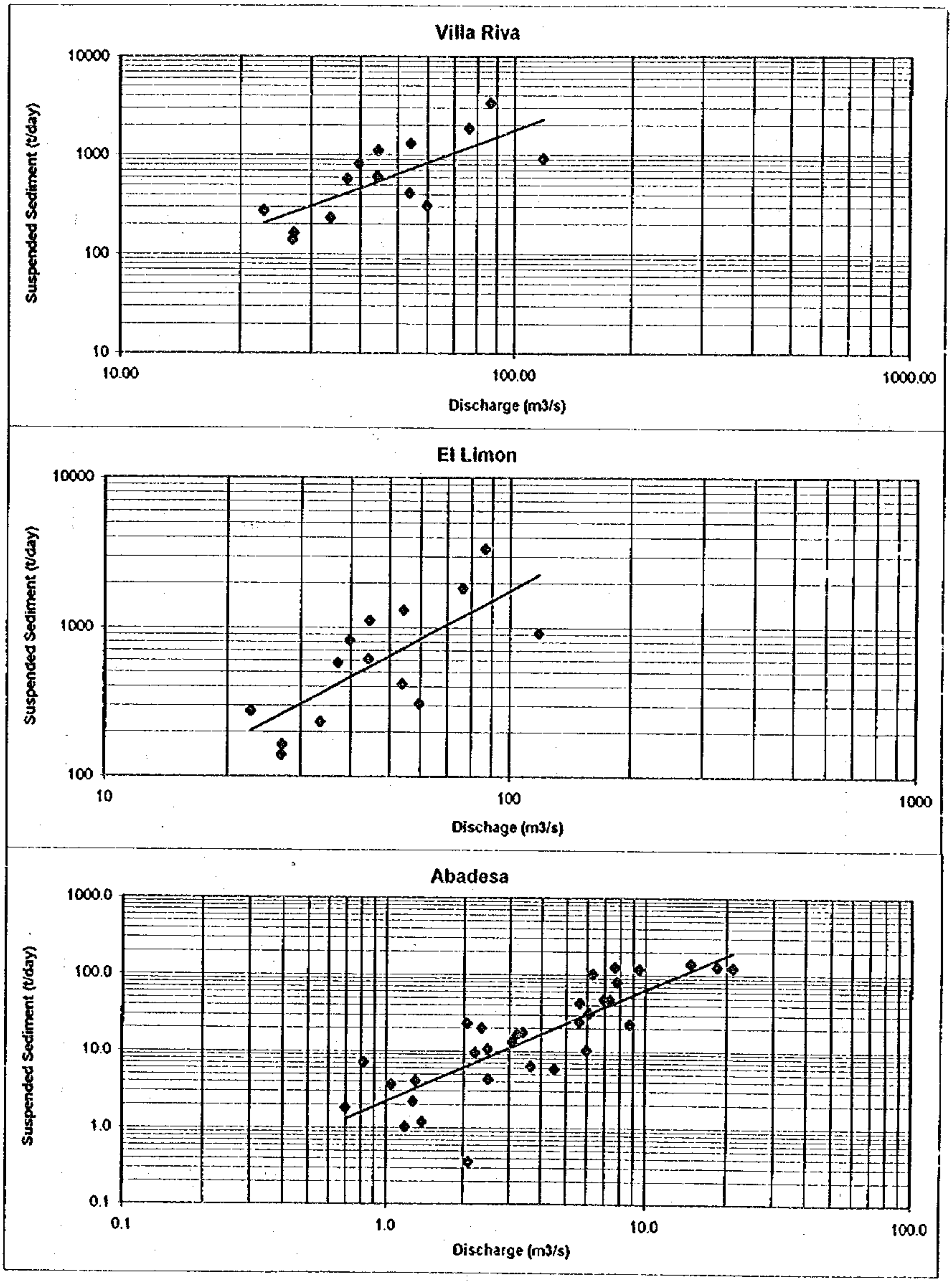
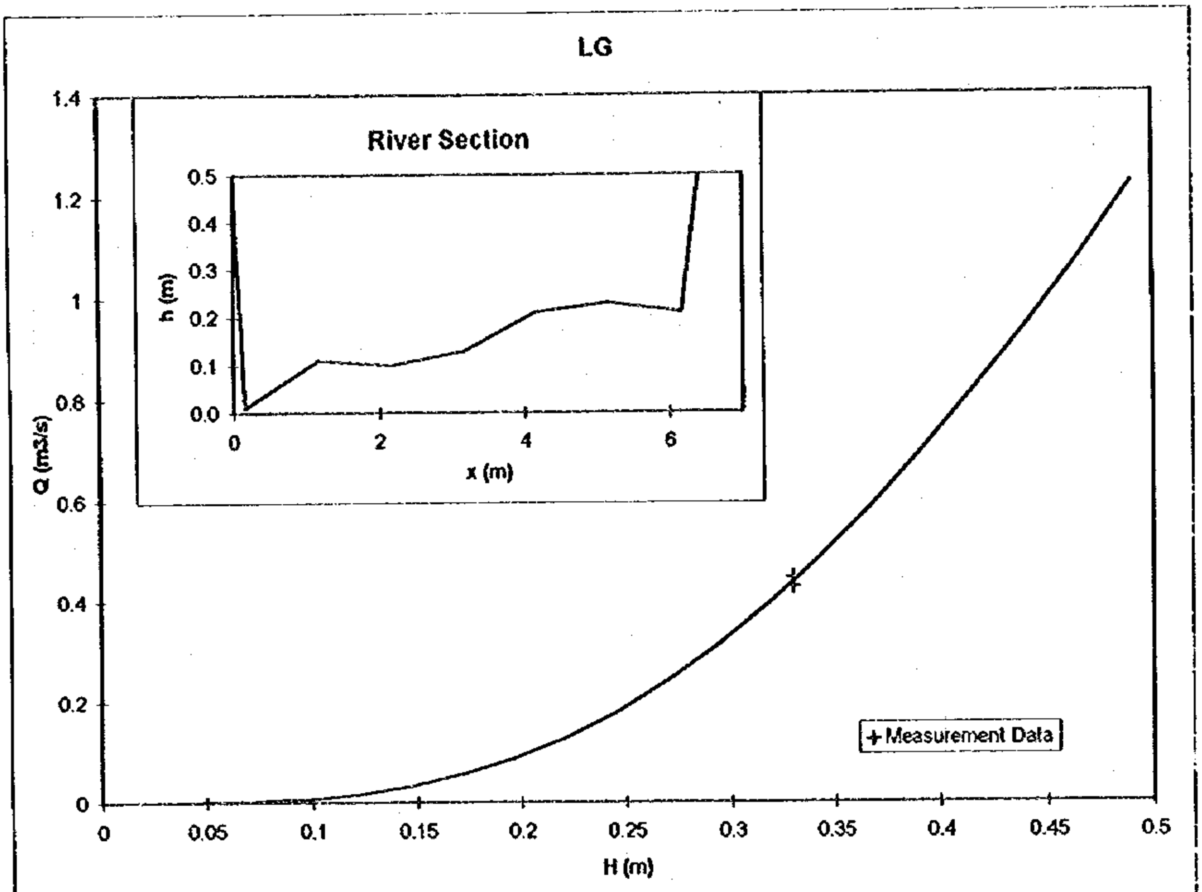


Fig. B.5.23 Result of Sediment Analysis



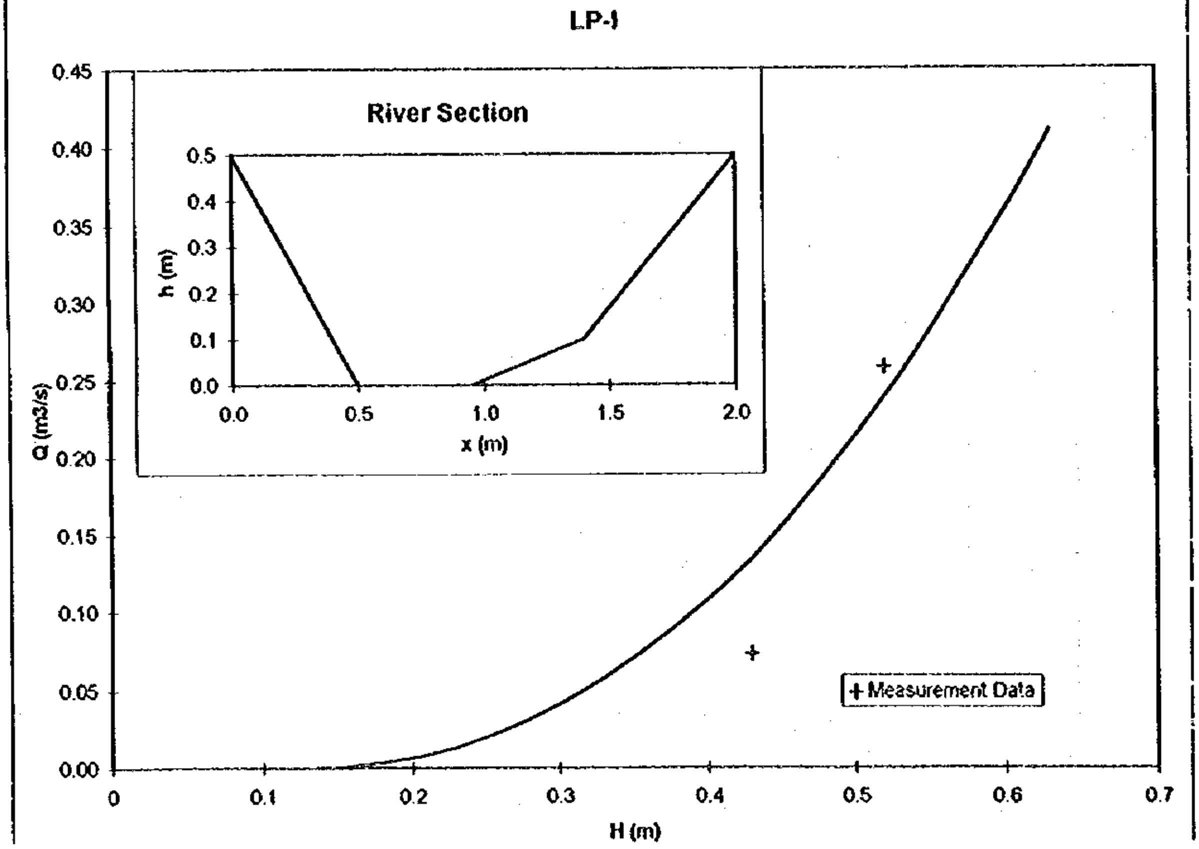
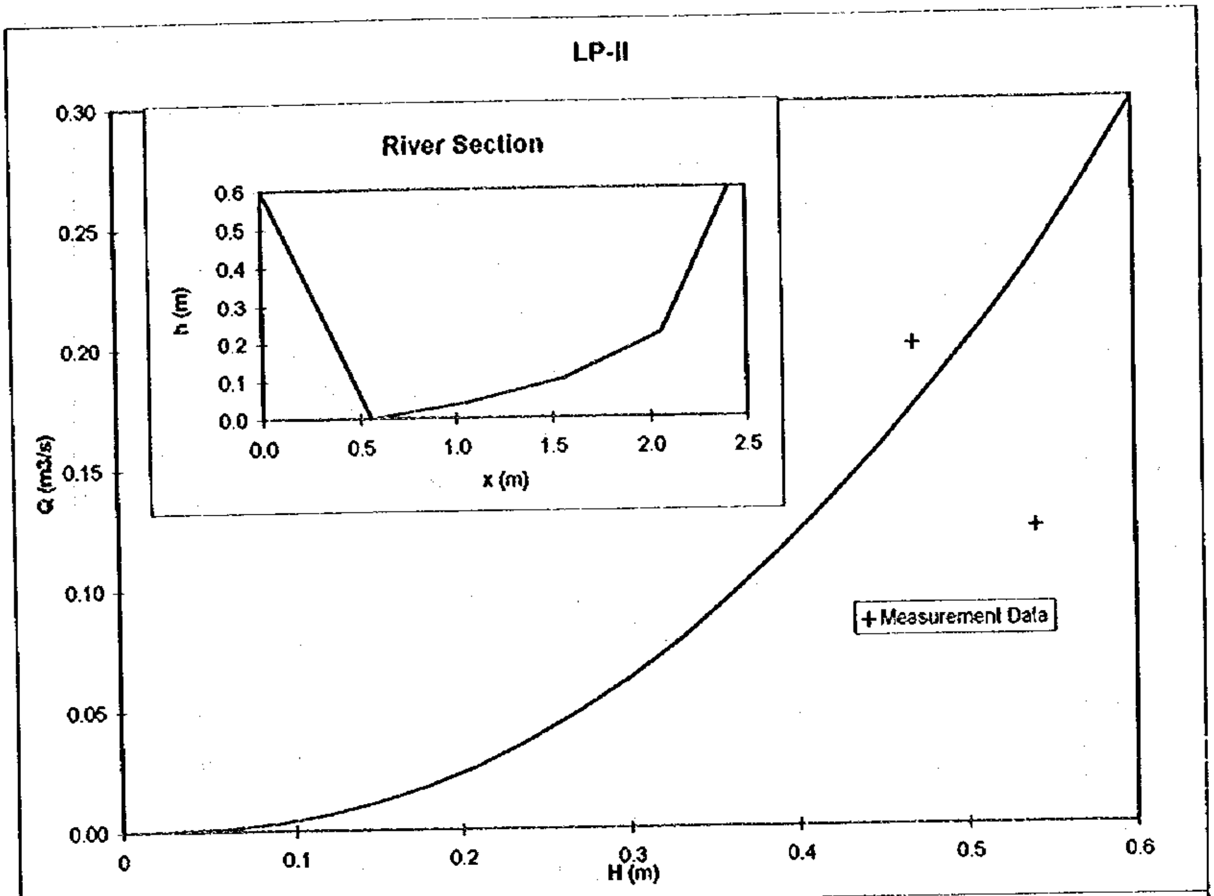


Fig. B.5.24 Estimated H-Q Rating Curve (1/9)



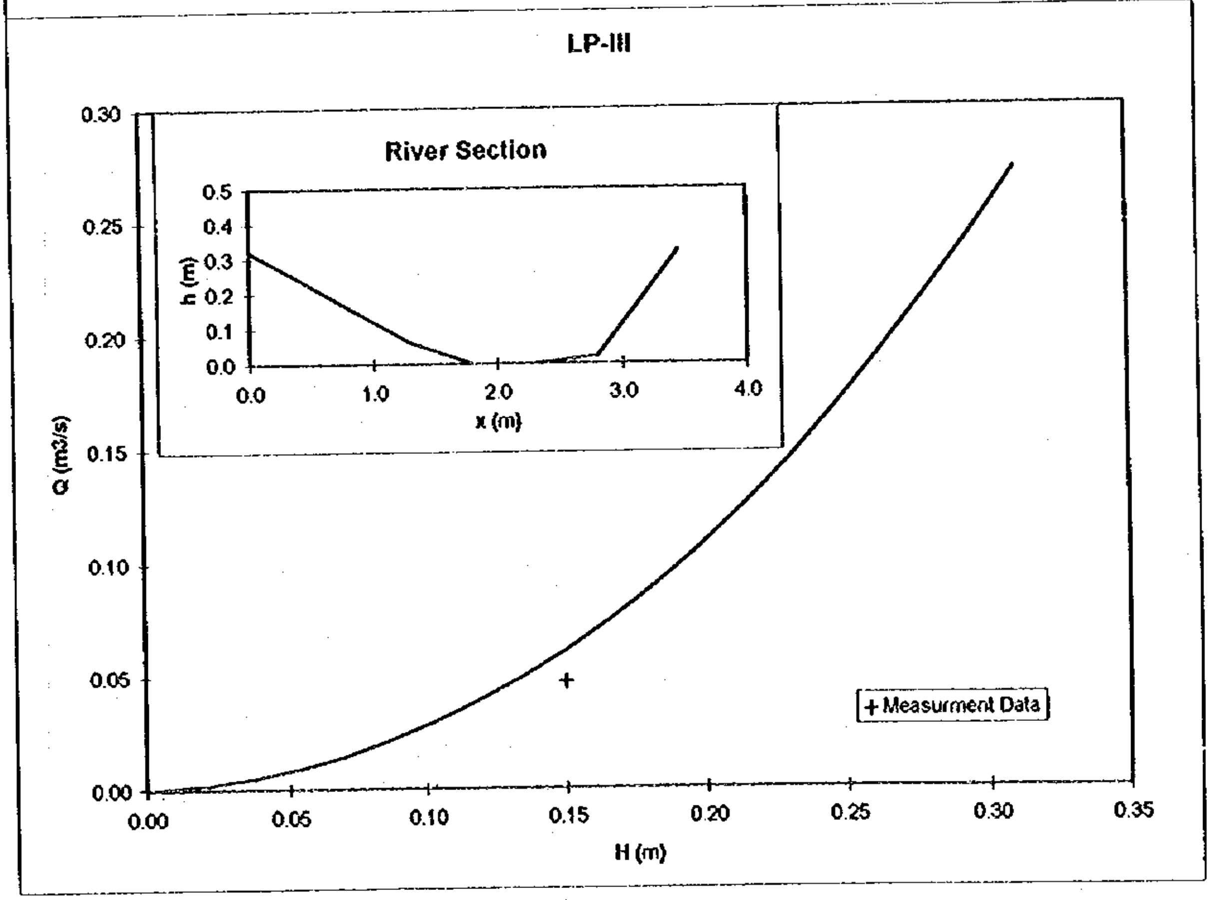
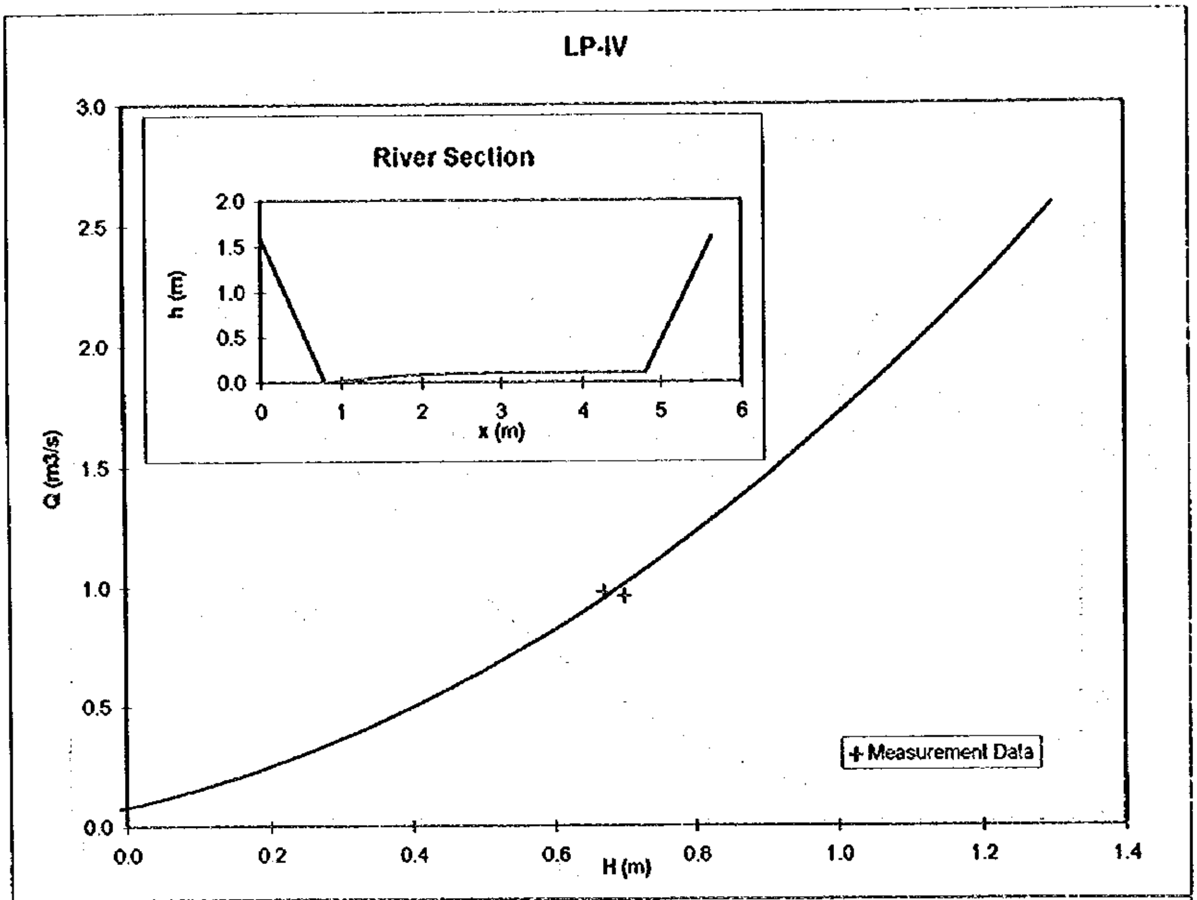


Fig. B.5.24 Estimated H-Q Rating Curve (2/9)



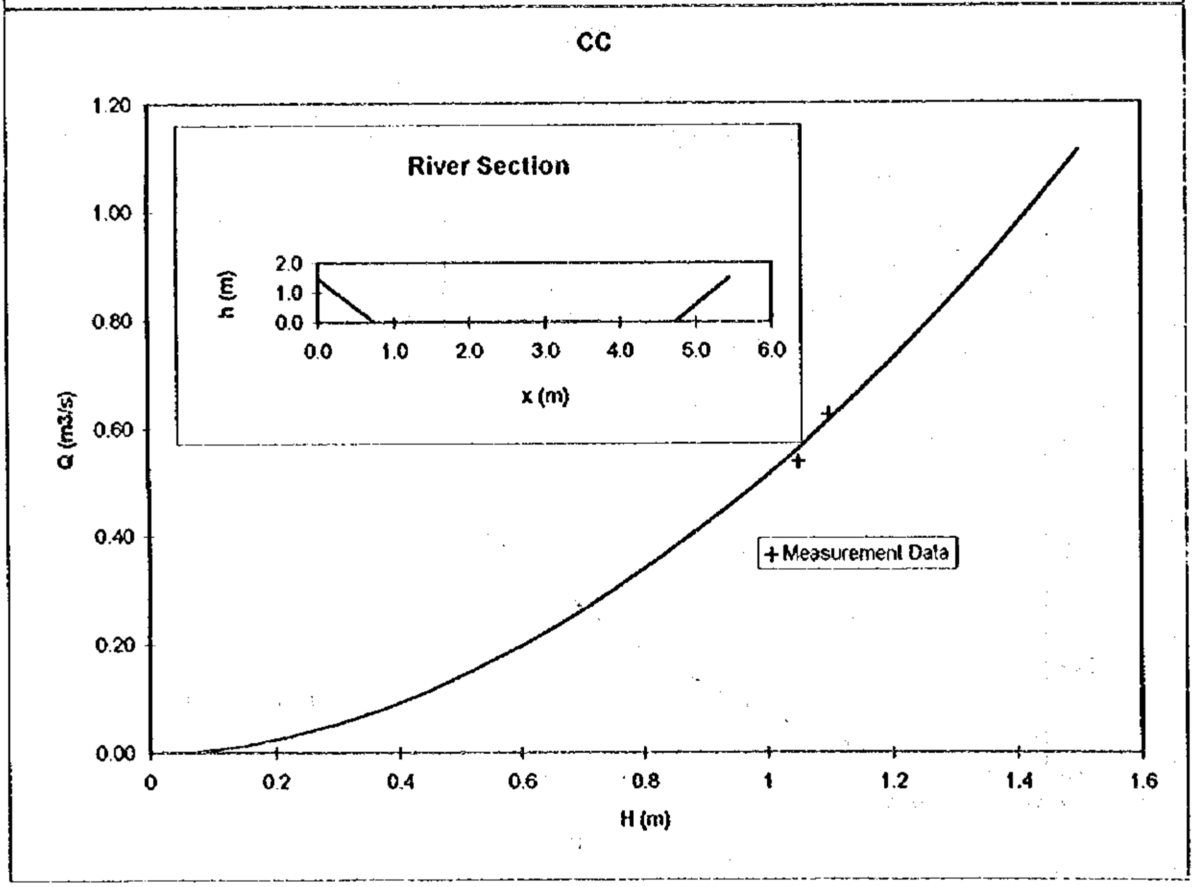
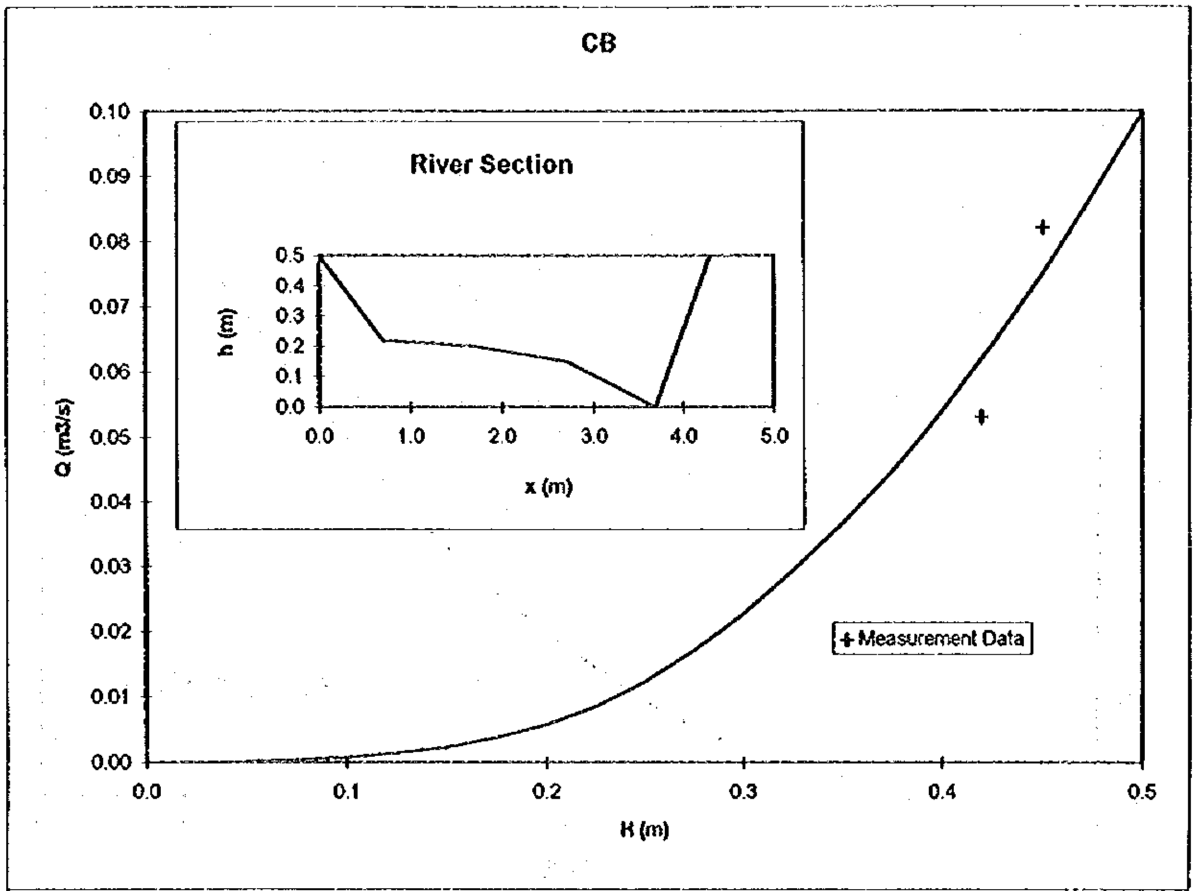


Fig. B.5.24 Estimated H-Q Rating Curve (3/9)



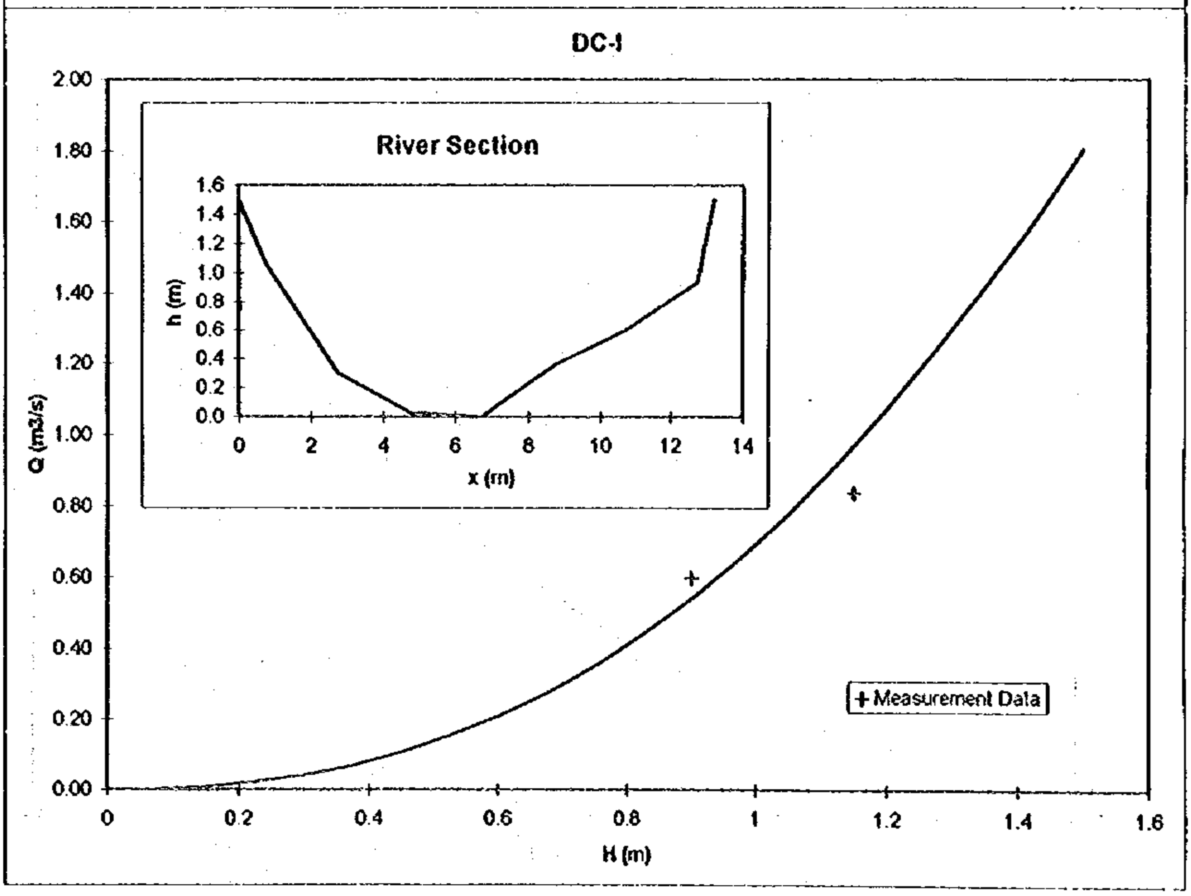
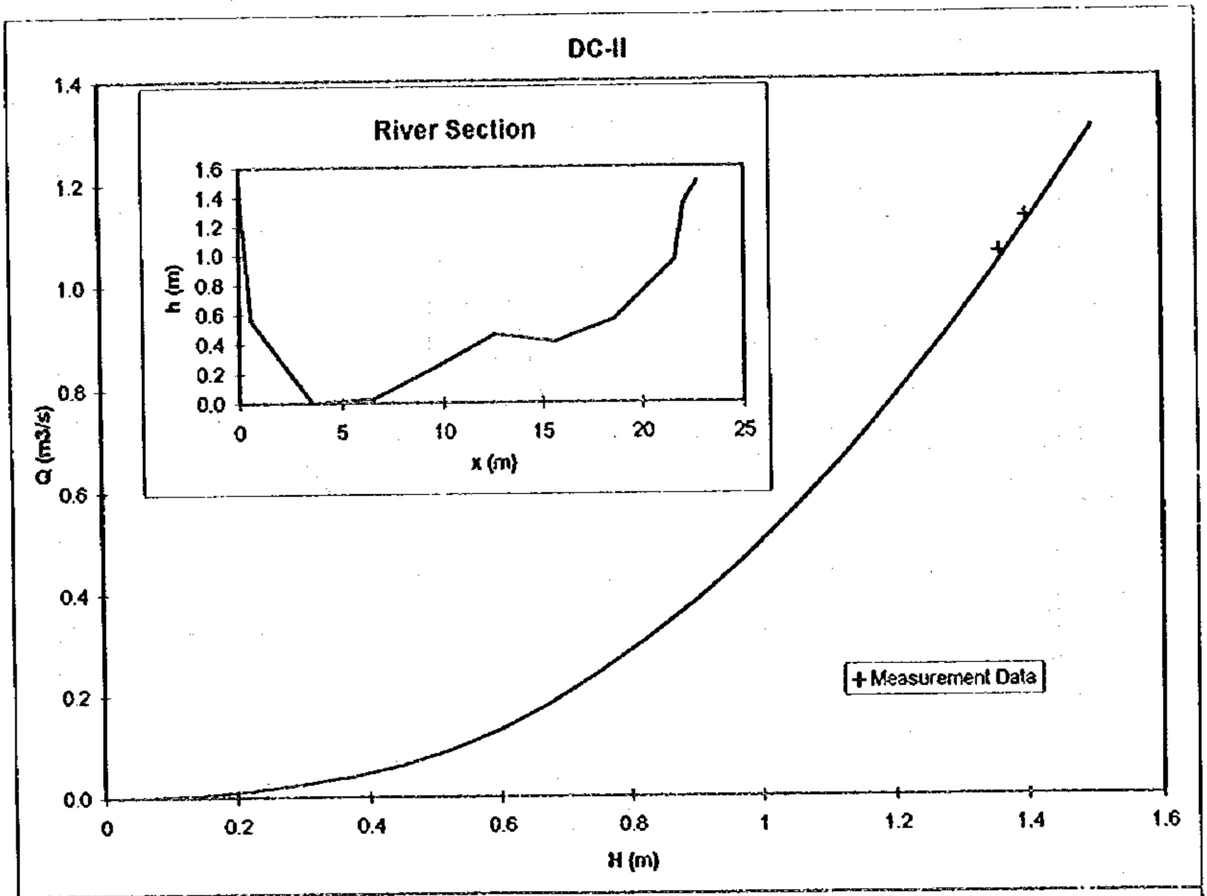


Fig. B.5.24 Estimated H-Q Rating Curve (4/9)



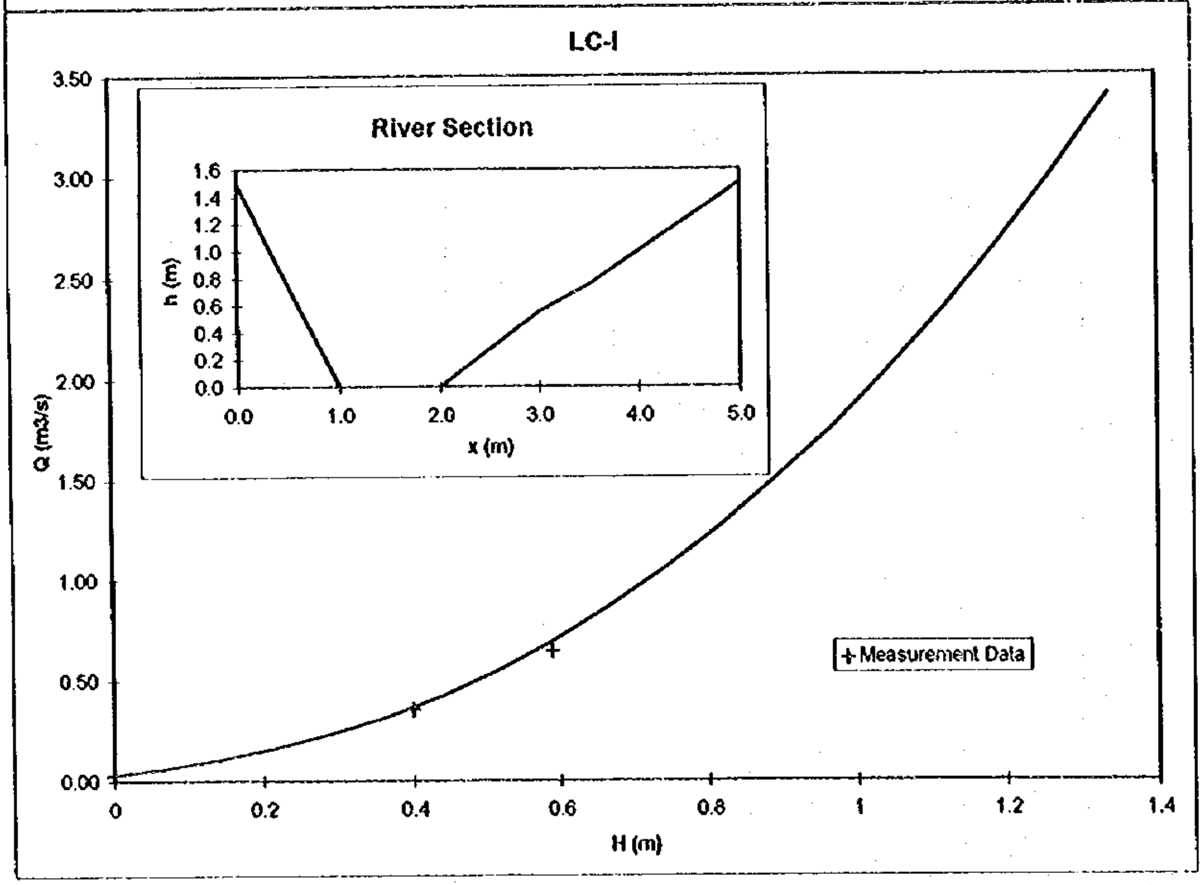
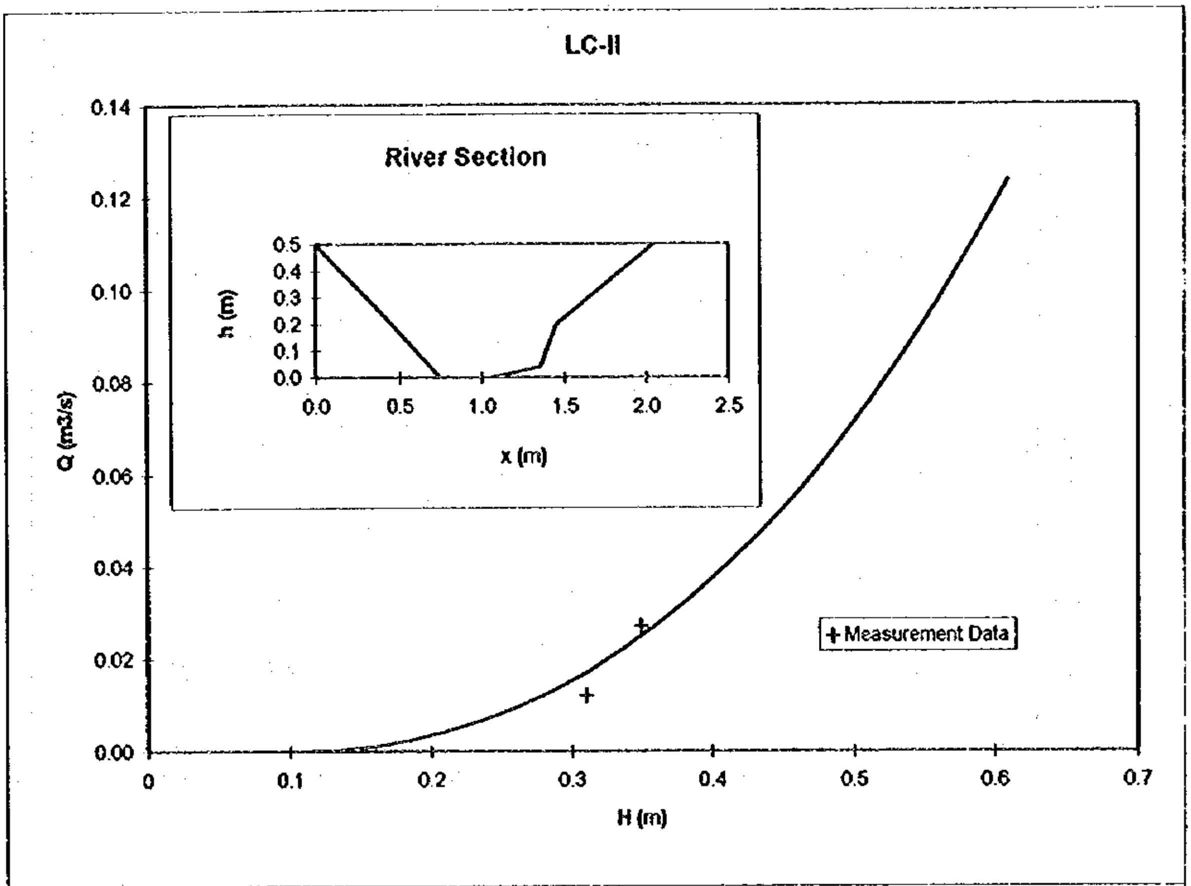


Fig. B.5.24 Estimated H-Q Rating Curve (5/9)



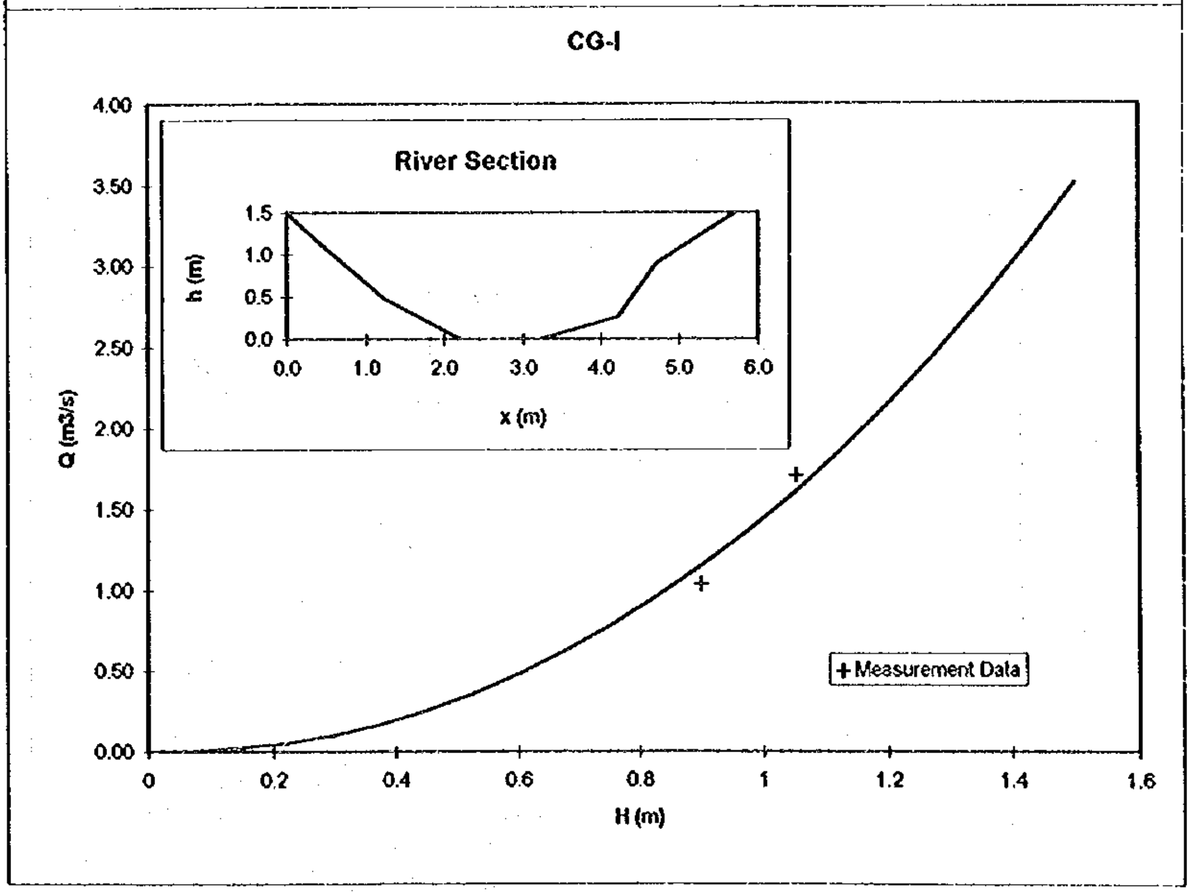
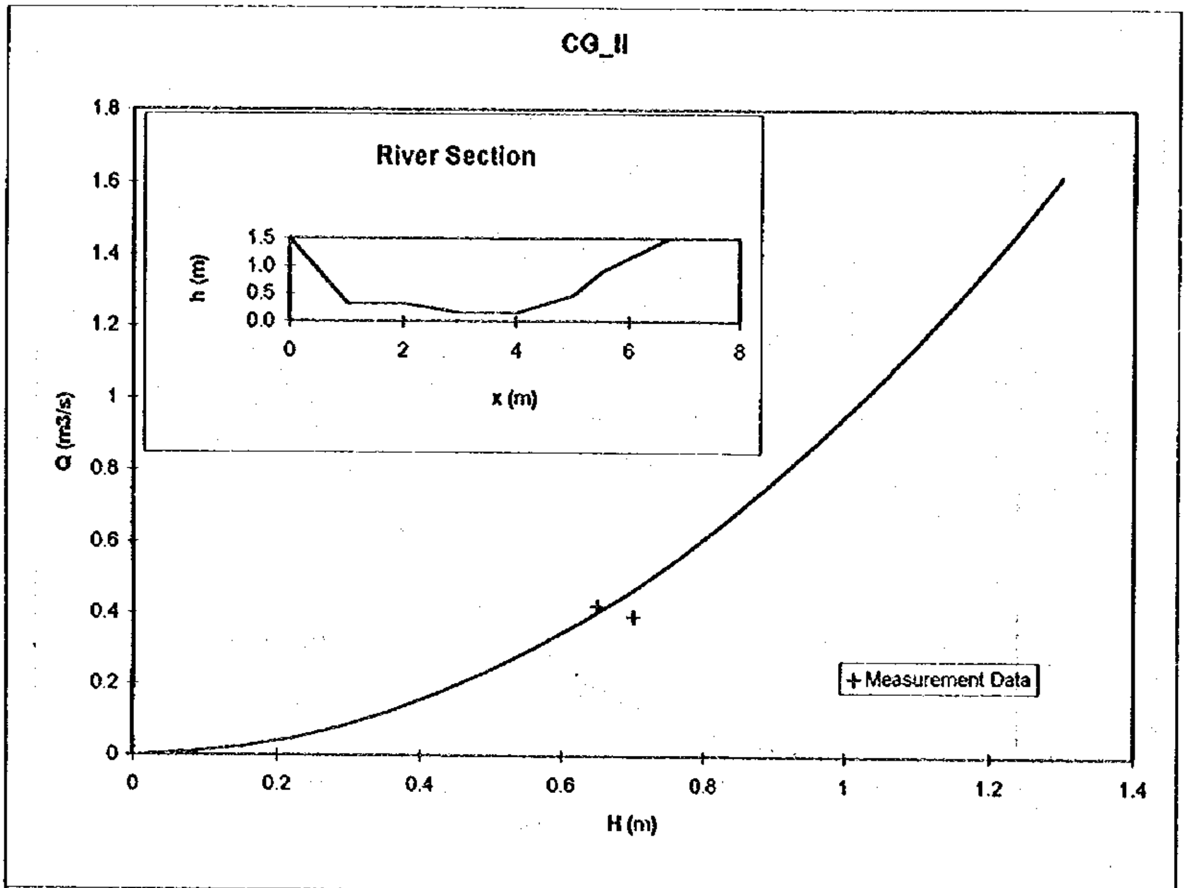


Fig. B.5.24 Estimated H-Q Rating Curve (6/9)



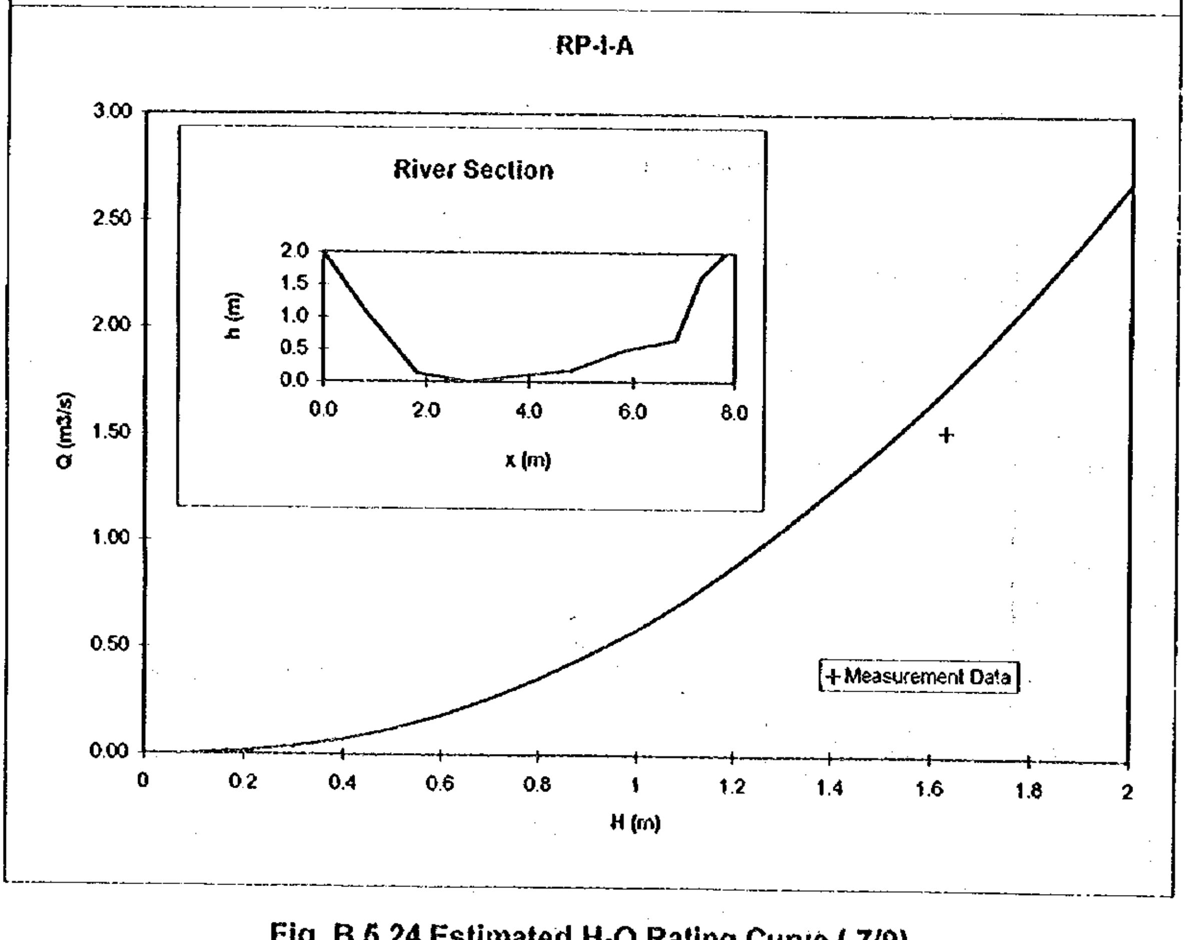
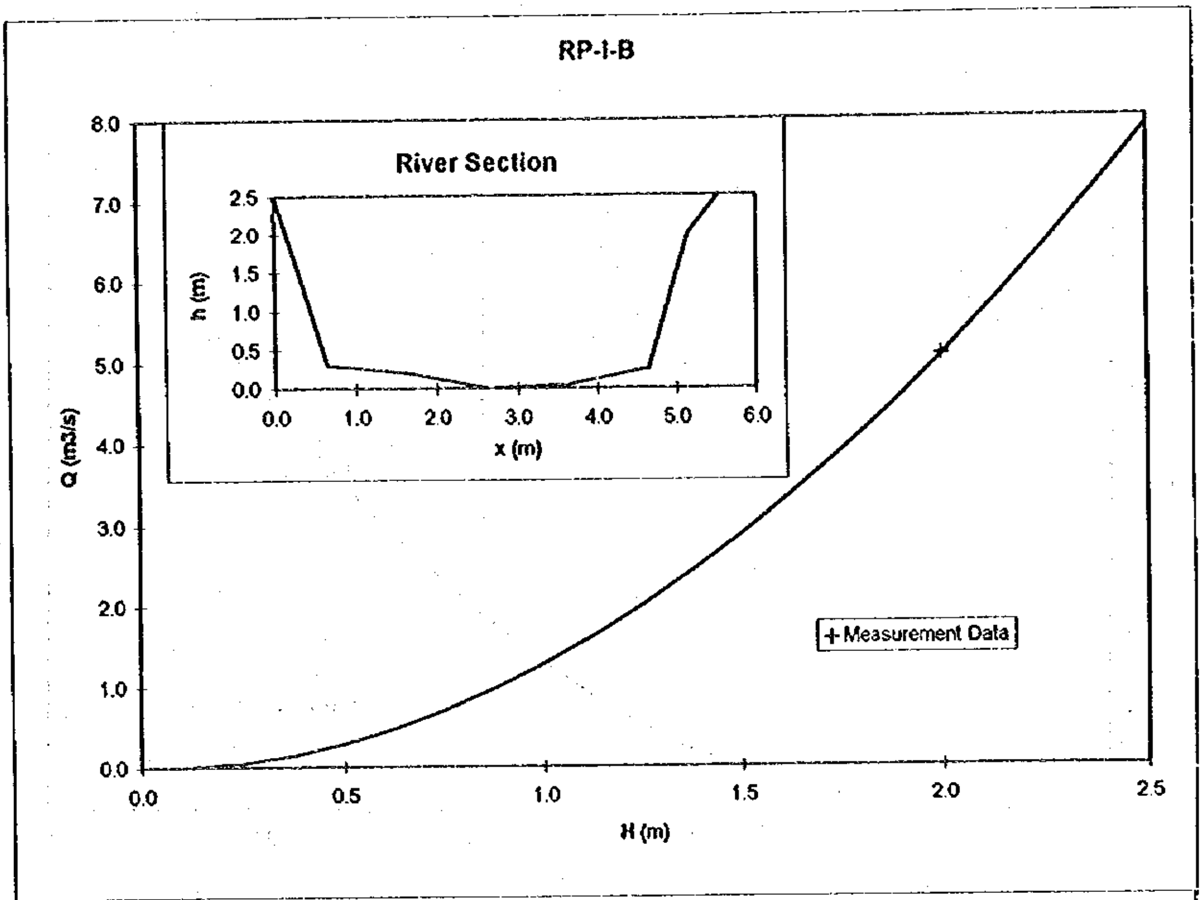


Fig. B.6.24 Estimated H-Q Rating Curve (7/9)



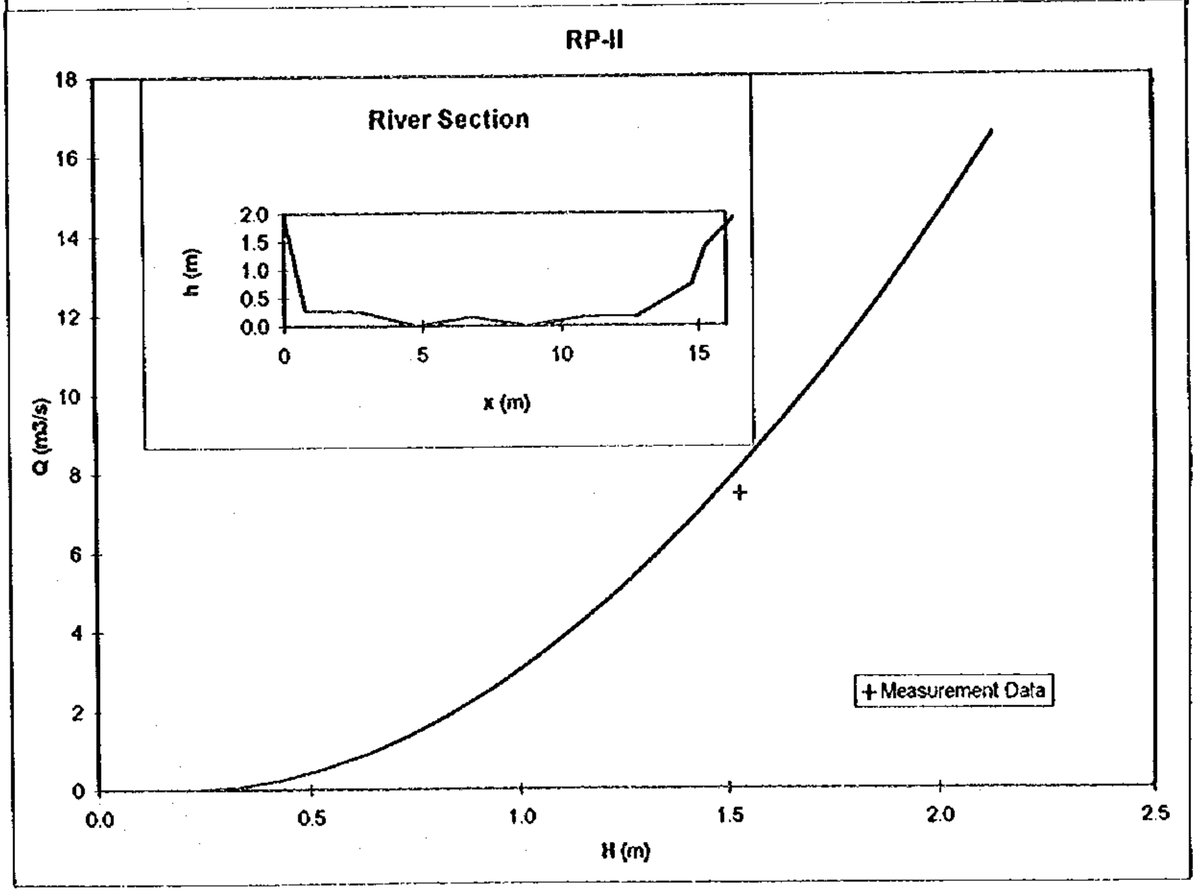


Fig. B.5.24 Estimated H-Q Rating Curve (8/9)

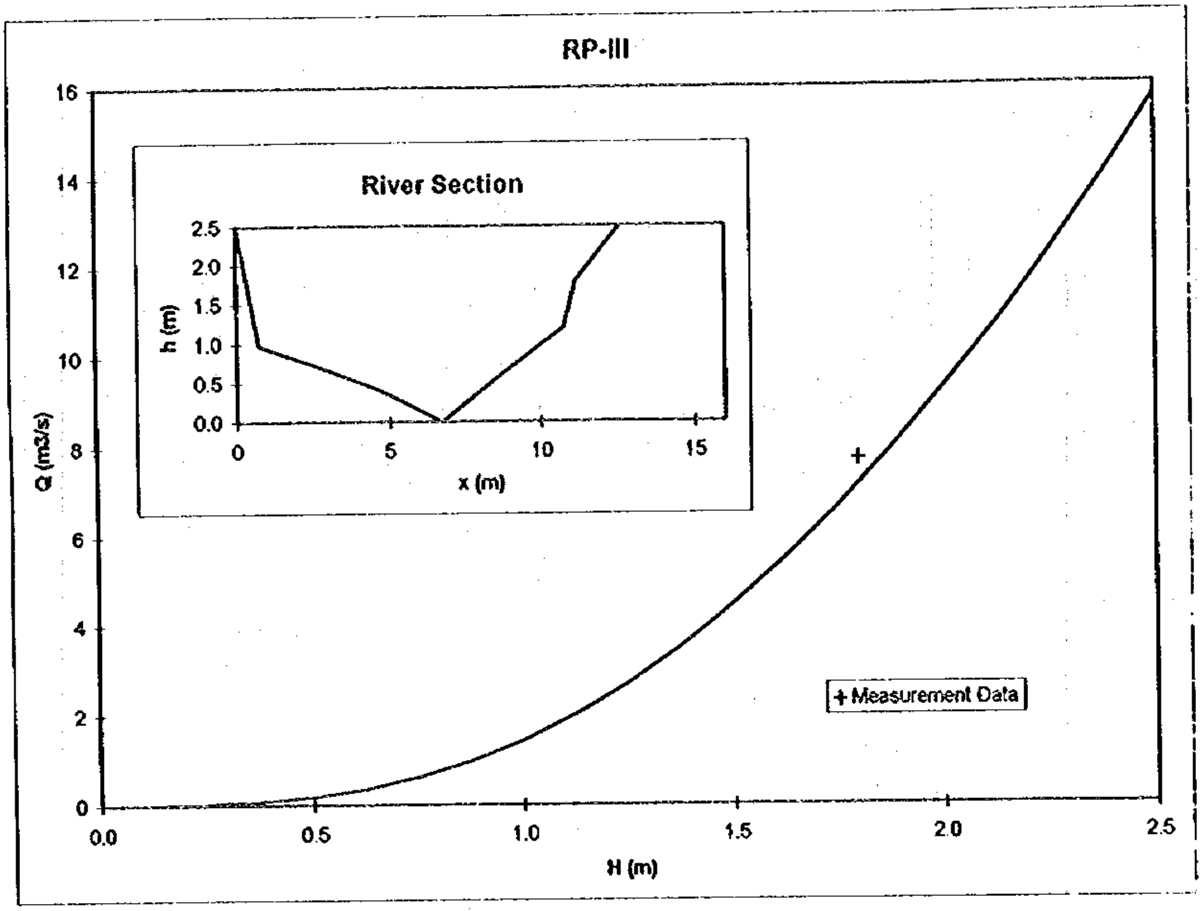


Fig. B.5.24 Estimated H-Q Rating Curve (9/9)

ANNEX C : TOPOGRAPHY AND GEOLOGY

ANNEX C: TOPOGRAPHY AND GEOLOGY

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ANNEX C: TOPOGRAPHY AND GEOLOGY

C.1 Introduction

A geological survey was carried out to verify the geological foundation and geotechnical properties of the study area.

C.2 Topography

The area is surrounded by mountains more than several thousand meters high; to the north the Septentrional mountain range and to the south the Central and Oriental mountain ranges. These mountains gradually ascend from west to the east. In the vicinity of the study area they are only about 100-300m. The study area itself is on a low lying alluvial plain about 5 - 20 meters above sea level, situated in between these mountains and formed from the deposits of the Yuna River, Payabo River, and Cevicos River which flow eastward. With a gradient of 1/1000, the area descends in the direction of the Samana Bay.

The south of the study area is bordered by the Los Haitises mountains where a karst region is found. A precipice originated by fault developments separates these two areas.

C.3 Geology

The study area is geologically divided into the northern mountains and southern mountains. The former is made up of metamorphic rocks, which are distributed on the northern side of the Nagua River, intercalated with composite cretaceous rocks. The latter is made up of the La Tabela and Las Sombrerito formations from the lower Eocene to the Middle Oligocene epochs. The southern slope of this mountain is distributed with Lagurabo formations of the Pliocene to the Pleistocene epochs.

These metamorphic rocks mainly consist of amphibolites and gneiss. The La Tabela formation and Las Sombrerito formation are mainly made up of conglomerates such as limestone, shale, andesites and sandstone. The La Gurabo formation is mainly made up of the stratification bedding plane layers of shale, tuff, and sandstone. The northern side of the study area is basically made up of metamorphic and composite rocks.

Composite cretaceous rocks widely distributed in the upstream area of the Yuna River make up the basement rock layer of the southern mountains. Limestone and calcareous sandstone of the Pliocene and Pleistocene epochs make up the Los Haitises mountains to the south of the study area.

Tertiary volcanic rocks distributed in the upstream area of the Yuna River, limestones that form the Los Haitises mountains, and the metamorphic rocks of the northern area all constitute the basement rock layer of the study area. Overlying this basement rock is a layer of Quaternary diluvial thin gravel, sands and clay, which in turn is overlain by alluvial sediments of the Yuna and

Payabo rivers. The alluvial sediments are from the Holocene epoch and mainly consist of clay and sand.

The geological map of the study area is in Figure C.3.1.

C.4 Field Investigation

Field investigation was carried out by excavating 10 exploratory boreholes and 2 borrow pits. Eleven (11) undisturbed samples were taken from the boreholes while two (2) samples of embankment material were taken from the borow pit. The extracted samples were analysed. Figure C.4.1 shows the location of exploratory boreholes and borrow pits in the study area.

C.4.1 Exploratory Boring

The quantity of exploratory boring carried out is shown in Table C.4.1.

Table C.4.1 Quantity of Exploratory Boring

No.	Location	Depth (m)	Standard Penetration Tests	Number of Undisurbed Samples
1	Payabo River	19.50	14	2
2	Ponton Pond	24.00	17	2
3	Cevicos River	12.00	9	-
4	Arrenquin Pond	12.50	10	1
5	PAYABO	15.00	12	-
6	Canal Guaranguao	10.50	8	2
7	REFORMA	10.50	8	1
8	Cascarilla Pond	12.00	9	1
9	Payabo River	24.50	18	2
10	Los Cocos	21.65	15	-
Total		163.05	120	11

C.4.2 Test Pit

Of the structures planned for the study area, the most important is the disaster prevention dam to be constructed on the Payabo River.

Two (2) types of soil material from the two borrow pits were selected based on the field survey results: soil consisting of flood sediments of the Payabo River, distributed in the vicinity of the study area, and soil made up of weathered limestone, namely Caliche, which is usually used as an embankment material of roads in the vicinity.

The dimensions of the borrow pit are 1 x 1 x 1.5m, and the embankment material was extracted from a depth of more than 1.5m. Table C.4.2 shows the number of borrow pits dug.

Table C.4.2 Number of Borrow Pits

No.	Location	Number of Samples
Tp-1	Rio Payabo	1
Tp-2	Rio Cevicos	1
Total		2

C.4.3 Laboratory Soil Testing

The undisturbed samples from the boreholes and the samples taken from the borrow pits were analysed in a laboratory in accordance with ASTM methods (American Society for Testing and Materials). Table C.4.3 shows the soil tests carried out.

Table C.4.3 Laboratory Soil Tests

Type of Test	Number of Samples		
	Undisturbed Samples	Embankment Materials	Total
Physical Property Test			
· Specific Gravity	11	2	13
· Water Content	11	2	13
· Grading Analysis	11	2	13
· Allerbert's Limits	11	-	13
· Unit Weight	11	2	11
Mechanical Property Test			
· Triaxial Compression (UU)	11	2	13
· Consolidation	11	-	11
· Compaction	-	2	2

C.5 Study Results

C.5.1 Exploratory Boring

The exploratory boring results are shown in Table C.5.1, while Figure C.5.1 shows the geological profile. The results of the standard penetration test are shown in figures C.5.2 and C.5.3. The details of the results are shown in Appendix C.1.

Table C.5.1 Results of the Exploratory Boring

Geological Period	Epoch	Symbol	Soil Quality	Thickness of Layer (m)	N-Value	Average N-Value
Quaternaly	Alluvium		Gravely Clay	0.8		
		Bs	Clay	-	3 - 17	8
			Sandy Clay	0.5		
		Ac	Clay-Sandy Silt	2.0 - 18.0	2 - 20	5
		As	Sand	3.0	10 - 41	27
		Ag	Gravel	2.0 - 4.0	37 - 50<	50<
	Diluvium	Dc	Clay	-	13 - 50<	28
		Ds	Sand-Clayey Sand	3.0 - 4.0	42 - 50<	50<
		Dg	Gravel	-	50<	
Tertiary	Pliocene	Tc	Clay	-	34 - 50<	46

As indicated in the geological profile, the ground foundation in the study area is divided into 8 layers.

(1) Topsoil (Bs)

The topsoil in the study area is mainly used for the banking of roads and rivers. Caliche, weathered limestone, is usually used for road embankments, while river levees are formed of clayey soil.

(2) Alluvium

The alluvial layer is made up of sub-layers of clay, gravel, and sand.

The clay sub-layer is distributed over the entire study area. It is 20m thick in the vicinity of Ponton pond, averages about 10m thick from Los Cocos to the Cevicos River to the west, and is 13m at the Payabo River where the disaster prevention dam will be constructed.

The thickness of this sub-layer increases in the northerly direction from the downstream section of the Arrenquin canal. But it is only 3 - 7m from Los Cocos to the direction of the Cascarilla drainage canals to the east. The N value ranges from 2 - 20, averaging 5.

The distribution of the sand (As) and gravel (Ag) sub-layers were investigated at the Arrenquin canal and Los Cocos area. The sand layer is made up of homogeneous fine sands, while the gravel layer mainly consists of rounded gravel. The N value in the sand layer ranges from 10 - 41, averaging 27, and 37 to more than 50 for gravel.

(3) Diluvium

The diluvial layer consists of three sub-layers: clay, sand and gravel.

The clay of this layer is distributed over the whole study area, except in the Cevicos River site, and is overlain by the clay sub-layer of the alluvial deposits. The clay in this layer is extremely hard with an N value ranging widely from 13 to more than 50; averaging 28.

The terrain is undulating and sedimentary changes are quite irregular due to the erosion and inundation brought about by the rivers Cevicos, Yuna and Payabo. In particular, a deep gorge has developed in the vicinity of the Ponton pond at the mouth of the Payabo River.

The sand layer (Ds) is evenly distributed in the Payabo River area and partially intercalated with clay. The *N* value has a narrow range, from 42 to more than 50.

The gravel layer (Dg) lies underneath the sand layer in the Los Cocos area. Gravel in this layer is round and measures 5 - 20mm. The *N* value is more than 50.

(4) Tertiary Pliocene

Clay (Tc) of the Tertiary Pliocene is restricted to the western end of the study area, the Cevicos River area. The core of this layer is made up of reddish brown clay. Underlying this layer is the basement rock that along with limestone constitutes the Los Haitises mountain. This basement rock layer has become clayey due to weathering. The limestone rock layer is mixed with a lot of gravel.

Caliche is the soil material most commonly used for road embankments in the study area.

C.5.2 Laboratory Test Results

The results of the analysis on the undisturbed samples and the samples of embankment materials are as shown below. The details are summarized in Appendix C.2.

(1) Results of the analysis of undisturbed samples

The results of the analysis are shown in Table C.5.2 and are summarized in Fig. C.5.4 - C.5.8.

Table C.5.2 Results of the Analysis of Undisturbed Samples

Characteristic				Number of Boreholes						
				No.1	No.2	No.4	No.6	No.7	No.8	No.9
Gradiation	Gravel		(%)	1-2	0-2	0	0-5	4	3	2
	Sand		(%)	6-8	10-11	5	11	14	13	8-17
	Silt+Clay		(%)	90-93	89-90	95	84-89	82	82	81-90
Consistency	Liquid Limit	WL	(%)	45-46	42-44	50	43-47	48	43	39-50
	Plastic Limit	Wp	(%)	21-23	22-24	22	22-24	22	22	20-23
	Plasticity Index	Ip	(%)	23-24	20-22	28	21-23	26	21	19-27
Specific Gravity of Soil		ρs	(g/cm³)	2.43-2.62	2.49-2.65	2.49	2.60-2.62	2.55	2.65	2.55-2.62
Natural State	Water Content	Wn	(%)	15-21	37-42	20	21-26	20	28	25-31
	Wet Density	ρt	(g/cm³)	1.79-1.81	1.79-1.80	1.86	1.80-1.84	1.79	1.77	1.83-1.89
	Void Ratio	e		0.56-0.75	0.91-1.09	0.60	0.75-0.79	0.71	0.91	0.74-0.81
	Degree of Saturation	Sr	(%)	65.1-73.3	100	83	72.8-86.2	71.8	82.6	86.1-100
Triaxial Compression	Cohesion	c	(kgf/cm²)	0.9-1.2	0.70	0.65	0.4-0.55	0.95	-	0.7-1.0
	Angle of Internal Friction	ϕ	(°)	0	0	0	5-6	0	-	0
Consoli-dation	Consolidation Yield Stress	Pc	(kgf/cm²)	1.40	1.30	1.10	1.40	1.30	1.40	1.30-2.30
	Compression Index	Cc		0.225	0.14	0.17	0.23	0.17	0.15	0.06-0.15

1) Physical Characteristics

The gradation curve of alluvial clay in Fig. C.5.4 shows that more than 80% of the alluvial clay is made up of fine grained soil (silt and clay). The consistency properties of this clay type: liquid limit (WL) of 39-50%, plasticity limit (Wp) of 20-24%, plasticity index (Ip) of 19-29. These figures are classified under "CL" in the plasticity chart shown in Fig. C.5.5.

Soil density (ρs) was observed at 2.43 - 2.65 g/cm³. The natural water content (*Wn*), 15-42%, was considered low for a clay layer. Wet density was measured at 1.77-1.89 g/cm³.

2) Mechanical Properties

The shear strength properties of the alluvial clay (Ac) are shown in Figures C.5.6 and C.5.7. Although the values range widely, the average cohesion, c = 0.90 kgf/cm² led to the conclusion that the angle of internal friction (ϕ) is 0.

Figure C.5.8 shows the relationship between the preconsolidation pressure and depth plot of alluvial clay. Although the values vary widely, consolidation shearing strength was found to increase with depth, a condition that exceeds the limits of the effective overburden pressure (σv). Therefore, clay in this layer is considered to be excessively consolidated with an average overconsolidation ratio of 2.

(2) Embankment Material

The results of the analysis of embankment materials are shown in Table C.5.3 and summarized in the figures (Fig. C.5.9 - 12).

Table C.5.3 Result of Embankment Material

Characteristic				Number of Boreholes	
				Tp-1	Tp-2
Gradiation	Gravel		(%)	64	7
	Sand		(%)	24	14
	Silt+Clay		(%)	12	79
Consistency	Liquid Limit	WL	(%)	34	39
	Plastic Limit	Wp	(%)	18	21
	Plasticity Index	Ip	(%)	16	18
Specific Gravity of Soil		ρs	(g/cm³)	2.67	2.60
Natural Water Content		Wn	(%)	18	29
Triaxial Compression	Cohesion	c	(kgf/cm²)	0.6	0.4
	Angle of Internal Friction	ϕ	(°)	8	3
Compaction	Maximum Dry Density	ρ dmax	(g/cm³)	1.927	1.531
	Optimum Moisture Content	Wopt	(%)	12.0	23.0

1) Physical Properties

The gradation curve of embankment materials shown in Figure C.5.9 indicates that 64% of Tp-1 is gravel and 24% is sand. On the other hand, Tp-2 is considered clayey as it is 80% fine grained soil (silt and clay).

The consistency properties are: liquid limit (WL), 34-39%, plasticity limit (Wp), 18-21%, and plasticity index (Ip), 16-18. These figures are classified under "CL" in the plasticity chart.

Soil density (ρs) ranges from 2.60-2.67 g/cm³ and natural water content (Wn) is 18% for Tp-1 and 29% for Tp-2.

2) Mechanical Properties

The relationship between soil moisture and density was assessed using a rammer and is shown in Figure C.5.11. The figure shows Tp-1 having a maximum dry density (ρ dmax) of 1.927 g/cm³ and an optimum moisture content (Wopt) of 12.0%. The maximum dry density (ρ dmax) and optimum moisture content (Wopt) of Tp-2 are 1.531 g/cm³ and 23.0%, respectively.

The results of the compaction test shows that compaction takes place when the maximum dry density is 95%. A triaxial compression test was then carried out on the compacted materials, the results of which are shown in Figure C.5.12.

The shear strength of the materials used are shown below.

Borrow Pit	Shear Strength	
	Cohsion (kgf/cm²)	Angle of Internal Friction (°)
Tp-1	0.6	8
Tp-2	0.4	3

(the shear strength figures shown above were obtained when the wet side of the materials was subjected to a 95% compaction).

If the wet weight of the materials was subjected to 90% compaction, the shear strength of these materials will significantly decrease as the water content exceeds the optimum water content by more than 5%. Accordingly, a compaction of 95% is required.

The shear strength of the embankment material is influenced by the degree the field is compacted. Therefore, it is necessary to re-examine field conditions and the construction works in the site.

C.5.3 Foundation Construction Plan

(1) From the Cevicos River to the Guaraguao Area

The construction of a spillway, cut-off gate, diversion weir, and drainage pipe and levee are planned for this area. As mentioned in the test boring results, the alluvial clay layer is thick in this area.

Hence countermeasures required for the construction of these structures are as follows:

1) Spillway • Cut-off Gate

As these are structures to be permanently constructed in the Cevicos River and Payabo River areas, their foundations should be stable to prevent ground subsidence. Accordingly, piled foundations are proposed.

In the Cevicos River area, the bearing layer will be the clay layer (Tc) of the Tertiary Pliocene, while the clay layer (Dc) of the Quaternary Diluvium will be the bearing layer in the Payabo River area.

2) Diversion Weir • Drainage Pipe • Levee Embankment

These structures will be constructed in the area of the Ponton pond, Arrenquin canal, and the Guaraguao drainage canal.

Since soil tests were not carried out on the surface layer, a bearing force of 5 tf/m^2 is estimated assuming the average N value five (5) meters from the surface layer.

The construction of the diversion weir and drainage pipe is possible in these sites as they are both comparatively small in scale and load. To construct a secure levee on soft grounds, a stable gradient should be established.

As to consolidation settlement, the construction of the levee is estimated to put an additional pressure of 1 - 2 tf/m^2 on the ground thereby compressing the clay layer reducing the original thickness by about 5 - 10%.

Given these conditions, extra banking methods are proposed.

(2) From the Reforma to the Cascarilla Drainage Canal

The construction of main roads is planned for these areas.

According to the exploratory boring results, the alluvial clay layer in this area is 1.5 - 2m thick. However, the roads in the vicinity of the study area and the boring sites are 1-2m lower than the paddy fields presumably because of the road embankments and consolidation due to traffic load.

The thickness of the alluvial clay layer in the paddy field area is estimated to range from 3-4m. Therefore, it is assumed that 50 - 60% of the alluvial clay (Ac) in the study area, according to the exploratory boring results, has been compacted. The laboratory tests also prove that this alluvial layer is made up of overconsolidated clay with a consolidation ratio of 2.

It is assumed that only about 5 - 10% of the clay layer will be compressed by the construction of the planned road embankment because the banking height will be limited to 1m, and the load, including traffic load, will only amount to 1 - 2tf/m^2.

(3) Payabo River Area

An intake weir and an earth disaster prevention dam are to be constructed in this site.

Outline of Dam Structure:

Type of dam:	Homogeneous dam
Length:	550m
Height:	12.2 ~14.8m
Gradient upstream:	1:3.0
Gradient downstream:	1:2.5

1) Stability of the dam

The embankment of a homogeneous earth dam is made of soil, and the dam itself is usually constructed on soft grounds. The slope gradient of this dam type is greatly influenced by the ground foundation and the strength of the bearing layer. Basically the gradient upstream is 1:3.0 ~ 4.0 and 1:2.0 ~ 3.5 downstream.

The dam will be constructed on soft grounds as the study area is distributed with the thick clay (Ac) layer. Therefore, the planned dam design should be followed to construct a stable dam.

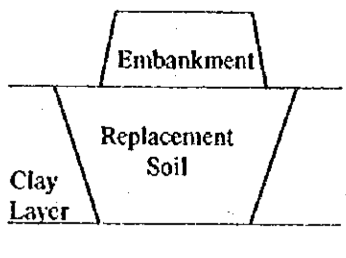
2) Consolidation Settlement

The construction of the dam will result in an additional ground pressure of 20 - 25tf/m². The clay layer that will remain after the excavation work for the dam is expected to settle by 10%. However the settlement may be greater if the clay layer is intercalated with a heterogeneous layer having a low N-value.

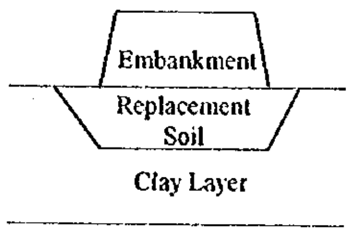
Given these conditions, the following methods were proposed:

Replacement Method

a. Complete Replacement

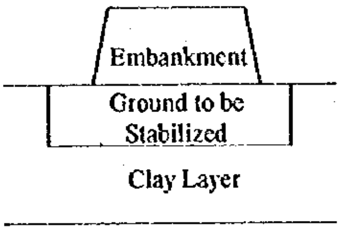


b. Partial Replacement

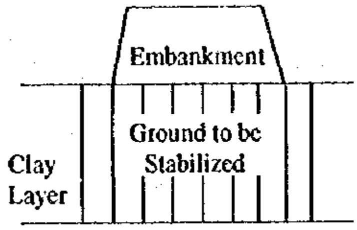


.   Stabilization Method

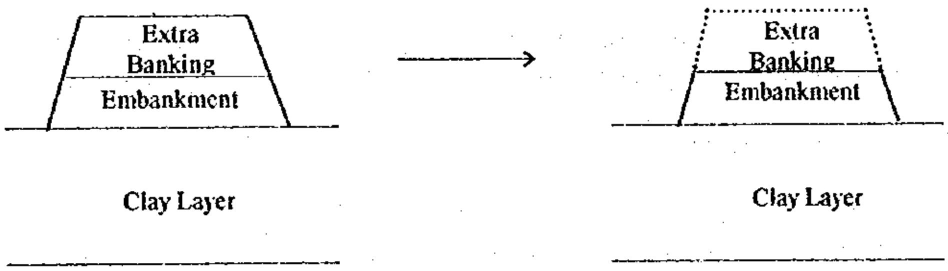
a.   Stabilization of shallow layer Method



b.   Stabilization of deep layer Method



.   Extra Banking Method



The replacement and stabilization methods in contrast with the extra banking method are not economical in terms of design or construction.